MANUAL

OF

TROPICAL MEDICINE

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PREFACE

THIS book is an attempt to describe the knowledge which we have found necessary to acquire and use during our work in Tropical Africa and Asia. We are well aware how difficult it is to discover one's own omissions and mistakes, and for such as may be found in this work we ask the indulgence of the reader.

An attempt has been made to keep the book as small as possible, but at the same time to describe, however briefly, the many subjects with which we have found it necessary to be acquainted. In order to attain this object, we have omitted all reference to practical laboratory methods, as such can readily be obtained in the excellent works of Daniels and Staunton, or Stephens and Christophers. Similarly, detailed descriptions of bacteria have not been included, as they are contained in any of the modern textbooks on bacteriology, such as those by Muir and Ritchie, by Hewlett, or by Stitt, one of which should be in the possession of every practitioner working in the Tropics. Notwithstanding our desire for brevity, we have considered it advisable in a few instances to repeat our descriptions of parasites in the clinical portion of the work. This, however, has only been done when such descriptions were necessary, in order to give the reader a clear general account of the disease.

In the Clinical Section we have given importance to the descriptions of treatment, going into details, which some may think superfluous; but we know by experience that these details as regards dosage, modes of administration, etc., are required by the practitioner working in the Tropics, who often has no opportunity of consulting books on therapeutics and materia medica.

We desire to acknowledge gratefully the sympathy shown to us by the officials of the Colonial Office in London during the preparation of this work.

We are indebted to Sir Hugh Clifford, K.C.M.G., Sir Allan Perry, M.D., Dr. Sambon, Dr. Willey, Mr. Green, Miss Robertson, Mr. Barnard, Mr. Browning, and Mr. Drieberg for reading certain portions of the proofs, and for kindly lending us specimens and illustrations.

It gives us great pleasure to express our thanks to our artists, Mr. Terzi and Mr. M. J. de Silva, for the skill with which they have executed the drawings. Though a large number of these are original, still we have been compelled in order to illustrate the work fully to draw upon the generosity of a number of authors and publishers. We desire to state how much we are indebted to the kindness of these gentlemen in allowing us to redraw their originals —a task which has been performed as carefully as possible, and it is hoped that no error has in any way crept in.

It is our desire to acknowledge in the fullest manner the source of these copied drawings, and if any omission is found it is purely accidental. We are especially indebted to Professor Looss, of Cairo, who with the greatest generosity offered us his valuable original drawings of worms; to Professor Nuttall, many of whose drawings of mosquitoes and ticks have been used; to Mr. Austen and the Trustees of the British Museum for several illustrations of mosquitoes and flies; to Professor Ross for permission to copy certain drawings from the publications of the Liverpool School of Tropical Medicine; and to Professor R. Blanchard, Professor Hartmann, Professor Fülleborn, the Honourable Charles Rothschild, Dr. Lesage, Dr. Rodewald, and Dr. Neveu-Lemaire, for permission to use some of their valuable drawings.

We have also to thank Colonel Sir William Leishman, the Honourable Mr. Warren, C.M.G. (Surveyor-General of Ceylon), Professor Grassi, Dr. C. Mense, Colonel Giles, Captain Christophers, Captain Craig, Captain Patton, Mr. Fantham, and Mr. Dobell, for kind permission to utilize their illustrations.

We have also to acknowledge the kindness of the authorities of the Royal Society, and of the Hygiene Laboratory of the Public Health and Marine Hospital Service of the United States, as well as the Editors of the *Archiv für Schiffs- und Tropen-Hygiene*, of the *Lancet*, of the *British Medical Journal*, of the *Archiv für Protistenkunde*, of the *Quarterly Journal of the Microscopical Science*, of the *American Journal of Medical Sciences*, of the *Journal of Hygiene*, and of the *Journal of Parasitology*, in allowing us to copy certain prints.

Finally, we desire to acknowledge the constant kindness and courtesy of our publishers, Messrs. Baillière, Tindall, and Cox.

ALDO CASTELLANI.
ALBERT J. CHALMERS.

COLOMBO, CEYLON.
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CHAPTER XXII

BIOLOGICAL CAUSES OF DISEASE (*continued*)

Vegetal parasites—Thallophyta—Algæ—Fungi—Phycomycetes—Ascomycetes—Basidiomycetes—Hyphomycetes—References.

VEGETAL PARASITES.

The vegetal kingdom is usually divided into the following four chief groups :

I. Thallophyta, a great variety of plants whose vegetative body may consist of one or many cells forming a more or less branched thallus.

II. Muscineæ or Bryophyta, including cormophytic forms as well as forms with a leaf-like thallus.

III. Pteridophyta, or fern-plants.

IV. Phanerogams, or flowering-plants.

THALLOPHYTA.

All vegetal parasites of man belong to the Thallophyta, which consist of two classes :

CLASS A. THE ALGÆ.—These possess chromatophores, while many species are provided with chlorophyl.

CLASS B. THE FUNGI.—No chromatophores and no chlorophyl.

CLASS A. THE ALGÆ.

The Algæ contain four orders :

I. Cyanophyceæ.
II. Chlorophyceæ.
III. Pheophyceæ.
IV. Florideæ.

Only the order Cyanophyceæ has importance from the point of view of human parasitology. The order contains two families :

I. Nostocaceæ, organisms containing chlorophyl.
II. Bacteriaceæ, organisms not containing chlorophyl.

The family Bacteriaceæ is very important, containing most of the pathogenic micro-organisms of man. As, however, the study

of bacteria forms a special branch of science, on which numerous works and textbooks are available, we shall not deal with it, reserving ourselves to describe only the non-bacterial fungi.

CLASS B. THE FUNGI.

Fungi play a very important rôle in human, animal, and vegetal pathology ; they also play an important part in some biological processes—for instance, *fermentation*.

The study of fungi is called ' mycology,' and a disease due to a fungus is termed a ' mycosis.' Thus ' otomycosis ' means a mycosis of the ear ; ' onychomycosis,' a mycosis of the nails ; ' dermatomycosis,' a skin disease due to fungi.

The investigation of fungi began long before that of *bacteria*. In 1837 Remak discovered the parasite of *favus*, which was more completely described by Schönlein in 1839. Between 1841 and 1844 Gruber described the fungi found in thrush and ringworm.

Morphology.—Fungi are Thallophytes without chlorophyl, and do not contain starch or chromatophores. Their vegetative body, or thallus, consists generally of a mass of filaments or threads termed the ' mycelium.' The threads or filaments forming the mycelium are called ' hyphæ.' The mycelial threads or hyphæ may be *septate* or *non-septate*. Their walls do not consist of ordinary cellulose, but of a substance known as *fungus-cellulose*, which does not stain blue by iodine and sulphuric acid.

Nutrition.—The fungi, being unprovided with chlorophyl, cannot make use of the carbon dioxide of the air, and therefore derive their carbonaceous food material from complex organic compounds, as, for instance, decaying organic substances.

Mode of Life.—Fungi live as parasites or as saprophytes. They may live one way or the other, according to circumstances. Fungi are parasites of man, of the lower animals, and of plants.

Reproduction.—The seeds of the Phanerogamia may be said to be represented in the fungi by the roundish or oval-shaped bodies called ' spores.' The spores multiply by budding, producing daughter spores, identical with the parent spores. Under certain conditions the spore, by a process of germination, gives rise to a true mycelial filament, which ramifies, producing mycelial hyphæ. Some of the terminal hyphæ are shorter and structurally different from the other hyphæ, and they become organs of fructification, which produce spores. The formation of spores upon these hyphæ takes place in various modes, of which five different types may be distinguished.

1. *Conidia or Exospores.*—These are non-sexual spores, which take origin by a process of budding or septation from the extremity of a germinal mycelial hypha or *sporophora*. The spores may all be of the same size, or, at other times, some are much larger *macroconidia*, others smaller *microconidia*. The conidia are at first always unicellular, but later they may divide and become multicellular.

2. *Chlamydospores or Endoconidia.*—These are asexual globular spores of great size, and provided with a thick membrane. Chlamydospores are terminal or intramycelial.

3. *Endospores or Gonidia.*—These spores take origin inside a special spore-case structure, or *sporangium*, which is often terminal and aerial. Endospores which are free and provided with organs of locomotion (cilia or flagella) are called *zoospores*, and the sporangium is known under the name of *zoosporangium.*

Ascus Fructifications, or *Asci*, are special sporangia containing four or eight or a multiple of eight spores arranged in a single line. These spores are called *ascospores.* Each ascospore presents two membranes, *one internal, one external.* The external membrane frequently shows a pore, which is called the *germinating pore.*

Basidia Fructifications.—Basidia are large elongated cells, each of which supports at its apex two or four slender processes (sterigmata), each terminating in a small roundish conidium or basidio-spore.

4. *Zygospores.*—These are the product of a process of conjugation or modified sexual act between two special hyphæ. These hyphæ emit small club-shaped branches, which come into contact and fuse together, giving rise to a new large cell, which presents a very resistant double wall. The special branches (*gametes*) which come into contact and unite to produce the *zygospore* do not show any apparent sexual differentiation.

5. *Oospores.*—These are formed by a complete sexual act or fertilization, and can therefore be compared with a fertilized ovum. The female element (*oosporangium, oogonium*) contains one or more roundish protoplasmatic masses (macrogametes or *oospheres*, *female gametes*), and presents a thick wall pierced by several *pores.* The male gamete (*antheridium*), which originates on a delicate special hypha, comes into contact with the oosporangium, sending a protoplasmatic process through it. In other cases the *antheridium* divides into several motile bodies called *microgametes, antherozoids,* or *spermatozoids,* which come into contact with the oosporangium, and fertilization takes place. In some rare cases the transformation of the oosporangium into an oospore is in reality a process of parthenogenesis.

Classification.—Fungi are divided into five orders :

I. Myxomycetes.—Higher fungi, mostly aerial ; many-celled mycelium ; reproduction by asexual spores.

II. Phycomycetes.—One-celled thallus, becoming septate only during sporulation ; reproduction takes place by asexual and sexual spores.

III. Ascomycetes.—Reproduction by asexual spores ; presence of *ascus fructifications.*

IV. Basidiomycetes.—Reproduction by asexual spores ; presence of *basidia fructifications.*

V. Hyphomycetes, or Fungi Imperfecti.—Fungi of very different groups, the botanical position of which cannot be determined with certainty in the present state of our knowledge.

The fungi parasitic in man are all found practically among the Phycomycetes, the Ascomycetes, and the Hyphomycetes. Only one species of importance is found among the Basidiomycetes, and none among the Myxomycetes.

ORDER PHYCOMYCETES.

This order is divided into three suborders :

I. Chytridiæ.
II. Oomycetes (oosporaceæ).
III. Zygomycetes or Zygosporaceæ.

The Phycomycetes parasitic on man all belong to the suborder Zygomycetes.

SUBORDER ZYGOMYCETES.

These fungi reproduce sexually and asexually. The sexual reproduction takes place by formation of *zygospores*. The asexual reproduction takes place by formation of conidia, gonidia (endospores), and chlamydospores (endoconidia).

The Zygomycetes are divided into four families, among one of which only—the Mucoraceæ—are found human parasites.

Family Mucoraceæ.

These organisms have a ramified thallus, branches taking origin laterally or by dichotomy. Some species are provided with *rhizoids*, root-like hairs by which they are attached to the surface on which they grow. From the surface of the mycelium some aerial branches called ' gonidiophores ' take origin, each of which supports on its distal extremity a pear-shaped, globular or claviform sporangium called *gonidangium*. The *sporangium* is at first separated from the gonidiophore by a septum, which later protrudes into the lower portion of the sporangium to form a variously-shaped structure termed the *columella*.

Inside the sporangium or gonidangium *endospores* or *gonidia* develop by free cell-formation.

The sporangium protoplasm not used in the formation of endospores gives rise to a peculiar mucilaginous substance, which at a later period, by absorption of water, causes the bursting of the sporangium. Each endospore or gonidium, when it has become free, gives rise to a mycelial tube by germination. This mycelial tube ramifies, and a new mycelium is formed.

In some species, under certain conditions a sexual reproduction may take place. This consists in the conjugation of undifferentiated non-motile gametes, which leads to the formation of zygospores.

Many species, when vegetating in unfavourable media, reproduce only by formation of conidia and chlamydospores.

Mucoraceæ are extremely common as parasites or saprophytes of plants and animals. A mycosis due to these parasites is often termed ' mucormycosis.'

Mucoraceæ can be easily grown on sugar culture media—for instance, Sabouraud's maltose agar—or even on ordinary agar. The optimum

temperature for their growth is between 35° and 40° C. The Mucoraceæ require plenty of oxygen, and therefore the media tubes must never be closed with rubber caps. When there is not enough oxygen, the Mucoraceæ lose their characteristics, and give rise to oidium or yeast-like forms.

Classification.—Four genera of Mucoraceæ are found to contain species parasitic on man :

Family Mucoraceæ.
- Mycelium ramified, no rhizoids—*Mucor*.
- Mycelium non-ramified, with or without rhizoids; peduncle supporting sporangium terminates in a special formation, encircling the base of the columella —*Lichtheimia*.
- Mycelium with rhizoids; columella ovoid —*Rhizomucor*.
- Mycelium with rhizoids; columella hemispheric, shaped like a mushroom—*Rhizopus*.

Genus Mucor Micheli 1729.

Mucor mucedo Linnæus 1764.

Synonyms.—*Mucor vulgaris* Micheli 1729, *M. sphærocephalus* Bulliard 1791.

Hyphæ carrying sporangia (sporangiophores) are long and erect; the sporangium is globular, 100 to 200 μ in diameter; its colour brownish; its surface covered by fine, minute crystals of oxalate of calcium. The spores (gonidia) are elliptical, with a smooth surface. The columella is ovoid-shaped, and generally yellowish. Occasionally very large zygosphores may be observed.

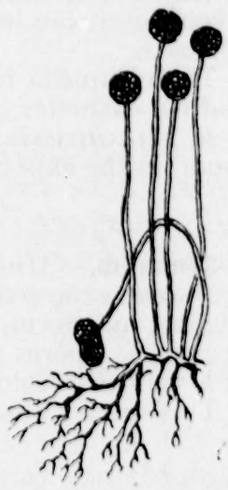

FIG. 265.—MUCOR MUCEDO.

M. mucedo L. is very common, living in organic substances in decomposition —for instance, horse-dung. It is the cause of a deadly disease in bees, but is seldom found in man.

Mucor pusillus Lindt 1886.

Mycelium at first white, then yellowish. The hyphæ carrying sporangia are much shorter than in the preceding species. The sporangium is globular, at first pale greyish, then dark greyish. Its diameter varies between 50 and 80 μ. The columella is claviform, ovoid or spherical, yellowish or brownish. The spores are smooth, spherical, 3 to 3·5 μ in diameter.

M. pusillus is often found in bread which has been soaked in water. It is very pathogenic to rabbits; it has occasionally been found in man.

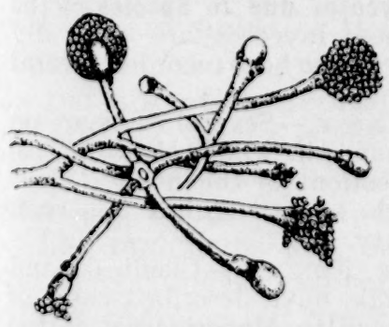

FIG. 266.—LICHTHEIMIA CORYMBIFERA VUILLEMIN.

(After Lichtheim.)

Genus Lichtheimia Vuillemin 1904.

Lichtheimia corymbifera Cohn 1884.

Synonym.—*Mucor corymbifer* Cohn 1884.

Mycelium first white, then yellowish. The sporangia are pear-shaped, 10 to 70 μ in diameter; columella conical, dark greyish or brownish; spores elliptical, 2 to 3 μ. The hyphæ carrying sporangia are ramified in corymbiform formation. This parasite has been observed several times in man.

Lichtheimia ramosa Lindt 1886.

Synonym.—*Mucor ramosus* Lindt 1886.

Closely resembling *L. corymbifera*, but rhizoids are often present. The spores are larger, ovoidal, 4 to 7 μ in length. The columella is always smooth.

This species has been observed in man by Lindt. According to Vuillemin, it is frequently found in the nasal mucus of horses.

Genus Rhizomucor Lucet and Costantin 1900.

Rhizomucor parasiticus Lucet and Costantin 1900.

Mycelium at first greyish, later brownish. Sporangium globular, 35 to 80 μ. Hyphæ carrying sporangia are often ramified, and are between 1 and 2 centimetres in length. They are often provided at their basal portion with rhizoids.

The columella is ovoid or pyriform ; dark brownish ; spores ovoid ; longitudinal diameter, 4 μ ; transverse diameter, 2·5 μ.

R. parasiticus is pathogenic for the guinea-pig and rabbits. It has once been found in the expectoration of a woman.

Rhizomucor septatus von Bezold.

Synonym.—*Mucor septatus* von Bezold.

Rhizoids present ; sporangia spherical, with a smooth, or occasionally slightly muriform, surface. Diameter about 30 to 35 μ ; columella spherical, brownish ; spores roundish or slightly oval, from 2·5 to 4 μ. The spores are of a yellowish colour.

This species was found by Siebenmann in a case of otomycosis.

Genus Rhizopus Ehrenberg 1820.

This genus contains only one species.

Rhizopus niger Ciaglinski and Hewelke 1893.

Synonym.—*Mucor niger* Ciaglinski and Hewelke 1893.

The mycelial filaments are provided with rhizoids. Sporangia globular, of black colour when ripe. Spores ovoid, smooth. Columella at first globular, but later takes a cylindrical shape, and when the spores have become detached, develops a peculiar mushroom appearance.

FIG. 267.—RHIZOPUS NIGER CIAG. AND HEW.
(After Ciaglinski.)

This species was discovered by Ciaglinski and Hewelke in a case of black mycosis of the tongue.

General Remarks on Mycoses due to Species of the Family Mucorinaceæ.—These mycoses are generally called mucormycoses. They have been recorded several times in man.

MUCORMYCOSIS OF THE NOSE.—Several cases are on record (Schubert, Siebenmann) in which Mucorinaceæ were found in various affections of the nose. Their pathogenic power in such affections has not been demonstrated with certainty.

MUCORMYCOSIS OF THE TONGUE.—Ciaglinski and Hewelke, and later Seniyiak, have described cases of so-called 'black tongue,' due to Mucorinaceæ of the genus *Rhizopus*.

MUCORMYCOSIS OF THE EAR—OTOMUCORMYCOSIS.—Several cases are found in the literature (Siebenmann, Böke, Huckel, etc.). Almost always *Lichtheimia corymbifera* was present. In the tropics we have observed two cases in which *L. ramosa* was present. When the fungus is in great quantity, the patient complains of tinnitus aurium and deafness—the same symptoms as those produced by a plug of cerumen in the external auditory meatus.

MUCORMYCOSIS OF THE LUNGS.—Several cases are on record. The patients generally complain of chronic cough, and the sputum may contain the fungi. Generally the mycelium only is found. Potassium iodide given in large doses produces good results.

GENERAL MUCORMYCOSIS.—One case only is on record—that of Paltauf. The patient during life presented fever, slight jaundice, enlargement of the spleen and liver, with signs of diffuse bronchitis and obscure nervous symptoms. At the post-mortem the brain presented several foci of a friable, yellowish substance ; the other internal organs showed nodules of various size, some rather hard ; others had undergone a purulent change. In all these formations mycelial threads were found ; in the lung nodules fructifications (sporangia) were also present, which enabled him to determine the fungus as *L. corymbifera*. According to Paltauf, the infection must have originated from the intestine, which showed several ulcerative lesions containing the same fungus.

ORDER ASCOMYCETES.

These fungi are characterized by their mode of reproduction—viz., by spores originating inside special cells called *asci*. The spores (ascospores, endospores, gonidia) inside the asci are generally four or eight or a multiple of eight. While these fungi live a parasitic life no asci are found, and reproduction takes place by germination and conidia. The fungi belonging to this order are often pleiomorphic, their morphological characters changing according to the medium on which they live.

The Ascomycetes are divided into two suborders :

I. *Gymnoascees.* — Asci not enclosed in any special enveloping structure.

II. *Carpoascees.*—Asci produced in special fructifications.

SUBORDER GYMNOASCEES.

Of the Gymnoascees, only two families—the Saccharomycetes and the Gymnoasceæ—are parasitic on man.

FAMILY SACCHAROMYCETES.

These organisms are generally round or ovoid cells, presenting a cell wall of single or double contour ; the internal protoplasmatic mass often shows granules and vacuoles. During active vegetation as parasites they reproduce by a *budding process*, hence the name of *budding fungi ;* when living on artificial media under unfavourable nutritive conditions, or in the absence of oxygen, they may multiply by formation of endospores or ascospores.

The organisms are, as a rule, unicellular plants, but at times the cells elongate to form mycelial hyphæ—so much so that occasionally a complicated ramifying septate mycelium is produced. This occurs, for instance, when the organisms are cultivated in certain fluid culture media—for example, fluid beer-wort. In such cases side-buds, which separate into conidia-like bodies may also develop on the hyphæ.

The family Saccharomycetes contains three genera :

I. *Genus Endomyces.*—Reproduction by external spores, ascospores, and spores situated inside the mycelial tubes.

II. *Genus Saccharomyces.*—No true mycelial threads; reproduction by budding and ascospores.

III. *Genus Cryptococcus.*—Reproduction by budding only; no *ascospores;* no mycelial threads.

The fungi belonging to the genus *Saccharomyces* and *Cryptococcus* are commonly known under the name of blastomycetes (or yeasts), while the diseases due to them are termed 'blastomycoses.'

Genus Endomyces Rees 1870.

Endomyces albicans Robin 1853.

Synonyms.—*Oidium albicans* Robin 1853, *Syringospora robini* Quinquand 1868, *Saccharomyces albicans* Rees 1877, *Monilia albicans* Zopf. 1890, *Endomyces albicans* Vuillemin 1898.

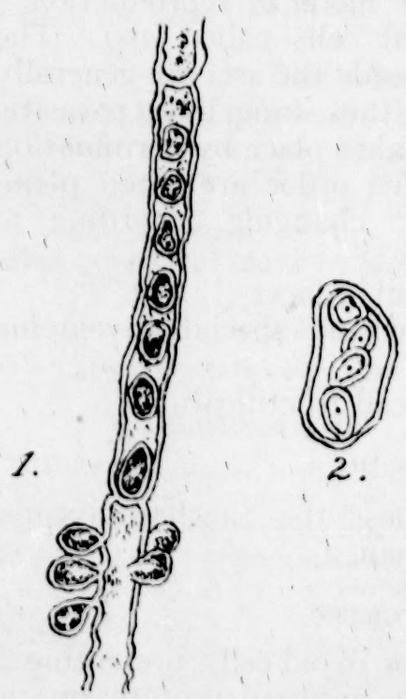

FIG. 268.—ENDOMYCES ALBICANS.

(From a culture. After Vuillemin.)

1, Mycelial threads, with endospores and conidia; 2, ascus fructification.

This fungus was discovered by Berk and Gruby in 1842 in thrush patches.

Parasitic Life.—This fungus forms white patches on the tongue and buccal mucosa. The patches are easily detached. A particle of the patch examined under the microscope shows: Septate mycelial threads, simple or ramified, the articles of which are straight or somewhat bent. Each article or cell is about 20 μ in length, and 3 to 5 μ in breadth. At the terminal portion of each mycelial thread three or four shorter ovoid elements are found which reproduce by budding. Some similar ovoid or roundish globular refringent cells may be observed, originating laterally at the septations of the mycelium. These globular elements, which were at first considered to be spores, become detached and reproduce by germination.

Saprophytic Life.—Culture Characters.—The fungus grows well on slightly acid Sabouraud's and other media; is very susceptible to alkalis; does not grow abundantly in alkaline media. Does not ferment lactose; some strains liquefy gelatine; Gram positive.

In cultures the fungus appears under two forms: 1. A filamentous form, showing the mycelial threads simple or ramified. 2. A globular form, morphologically similar to a typical yeast, and reproducing by budding. Both forms may be found in the same culture.

The fungus in cultures reproduces by—

1. Chlamydospores or external spores; large globular cells 10 to 20 μ in diameter, with thick resistant walls. The chlamydo-

spores are situated at the terminal extremity of some mycelial hyphæ, and represent modified mycelial articles.

2. Asci containing four ascospores.

3. Internal Spores.—These are oval cells with membrane, protoplasm and nucleus similar to the external spores. The internal spores are arranged in a single string inside some mycelial tubes.

Pathogenicity.—The fungus is the cause of the well-known affection termed *thrush*. It is generally localized in the oral mucosa, but in certain cases it may spread to the œsophagus, stomach, and intestine. It may be found in the lungs. Rarely it gives rise to a general infection producing a type of pseudo-tuberculosis. At times *Endomyces albicans* may show pyogenic properties.

In the tropics thrush is not rare; it is found in children and cachectic adults.

Endomyces subtilis Blanchard 1895.

Found in a pustular eruption of a child by Boyer J. d'Antin, 1881, and by Babes in a similar eruption in a woman.

Endomyces subtilis closely resembles *E. albicans*, but its filaments are much more slender.

Endomyces rhoi Castellani 1909.

Found by Castellani in several cases of tropical otomycosis. The mycelial threads are very long and septate, 3 to 4 μ in breadth;

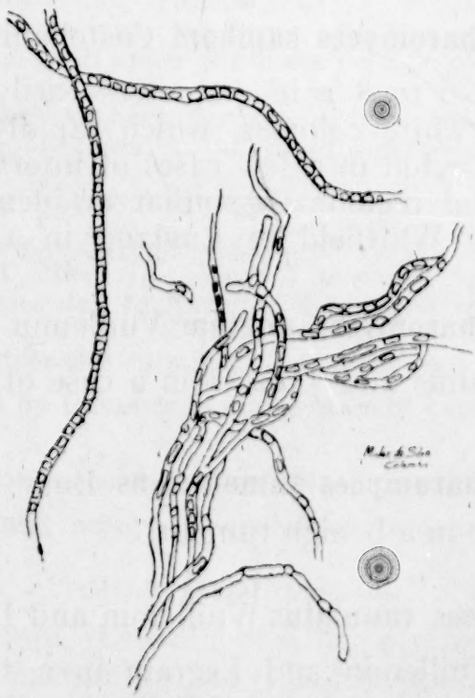

FIG. 269.—ENDOMYCES RHOI.
(From a fresh preparation. The free spores are not shown.)

there are very numerous free roundish cells, 4 to 5 μ in diameter. It grows on various sugar and ordinary media producing a whitish membranous growth.

Genus Saccharomyces.

No proper thallus. Reproduction by budding and endospores or ascospores.

As already stated, the fungi of this genus, as well as of the genus *Cryptococcus*, are usually called Blastomycetes, and the diseases induced by them blastomycoses.

The fungi of the genus *Saccharomyces* and *Cryptococcus* have a great importance in dermatology, as they give rise to peculiar ulcerative affections of the skin, often resembling a syphilide or a tuberculide. The first cases of blastomycosis were observed in America by Posadas, Wernike and others, who at first believed them to be a protozoal infection. Later Gilchrist, Ricketts, and others recognized the true nature of the parasites. Cases of blastomycosis are frequent in tropical countries. By some authors (Sanfelice, Roncali, etc.), cancer has been considered to be of blastomycetic origin.

Saccharomyces blanchardi Guiart 1906.

Found at an operation on a patient who had been considered to be suffering from tubercular peritonitis. The fungus had produced in the peritoneum a large whitish gelatiniform mass, weighing about 1 kilogram. The fungus grew well on all sugar media.

Saccharomyces samboni Castellani 1907.

Cells roundish—6 to 8 μ in diameter—easily grown on various media producing white colonies, which rapidly coalesce. Found by Castellani in Ceylon in a few cases of intertriginous dermatitis of the cruro-scrotal region. A similar or identical organism has been observed by Whitfield in England in a case of the same dermatitis.

Saccharomyces anginæ Vuillemin 1901.

Found by Achalme and Troisier in a case of tonsillitis showing white patches.

Saccharomyces tumefaciens Busse 1897.

Found by Busse in a benign tumour.

Saccharomyces ranulatus Vuillemin and Legrain 1900.

Observed by Vuillemin and Legrain in a tumour of the submaxillary bone.

Saccharomyces ellipsoides Rhees 1870.

Found by Maggiora and Gradenigo in a case of chronic otitis media.

Saccharomyces roseus Maggiora and Gradenigo 1890.

Found by Maggiora and Gradenigo in the Eustachian tube.

Genus Cryptococcus Kützing.

Reproduction by budding only; ascospores unknown; no fermentation of sugar media (glucose and saccharose).

Cryptococcus gilchristi Vuillemin.

Synonym.—*Oidium* (sp. ?) Gilchrist and Stokes 1896.

Found by Gilchrist and Stokes in a case of chronic ulcerative dermatitis, and later in a case which had been diagnosed as a tuberculide of the skin. After Gilchrist and Stokes's cases, other cases of blastomycosis due to an identical or similar organism have been described by Hyde, Oppenheim, Ricketts, etc. Ricketts considered these fungi to be species of *Oidium* (Endomyces), and proposed the name 'oidiomycosis' to indicate the disease produced by them.

C. gilchristi in the affected tissues has the appearance of a typical yeast—large, globular cells, reproducing by budding. In cultures, besides these globular elements, thread-like mycelial tubes may be found, presenting lateral or terminal conidia; ascospores absent. The fungus does not ferment glucose or saccharose.

FIG. 270.—CRYPTOCOCCUS GILCHRISTI VUILLEMIN. (After Gilchrist.)

Cryptococcus hominis Vuillemin.

Synonym.—*Saccharomyces* (sp. ?) Busse 1894.

Found in abscesses in a woman by Busse. In the pus the fungus presented itself under the shape of oval bodies, with a membrane having a double contour. These elements were arranged in groups, each group being surrounded by a special capsule. Culturally the fungus showed only roundish budding forms, no mycelium, no asci.

Cryptococcus linguæ-pilosæ Lucet 1901.

Synonym.—*Saccharomyces linguæ-pilosæ* Lucet 1901.

Found by Lucet and others in a case of so-called 'black tongue.' This affection is in other cases due to *Rhizopus niger*, and in others to *Oospora lingualis*.

Cryptococcus plimmeri Costantin 1901.

A *Cryptococcus* found by Plimmer in many cases of cancer. It is probably only a saprophyte.

Cryptococcus degenerans Roncali 1896.

Found by Roncali and others in malignant tumours: sarcomata and carcinomata.

FAMILY GYMNOASCEÆ.

Spherical perithecium, the walls of which are formed by mycelial filaments. At the extremities of these mycelial threads ascus fructifications are found. Besides vegetating under this type, the Gymnoasceæ can also vegetate under a filamentous or conidial form without any formation of asci. It is under this second form that most of the Gymnoasceæ parasitic on man vegetate.

The genera *Microsporon*, *Trichophyton*, *Achorion* are at the

present time considered to belong to the family Gymnoascees on account of the following facts :

1. These three genera, as demonstrated by Matruchot and Dassonville, have the greatest resemblance to the filamentous type of some typical Gymnoascees.

2. A species of Gymnoascees, *Ctenomyces serratus*, when living saprophytic, shows perithecia and ascus fructifications ; when inoculated into animals, vegetates under a filamentous form very similar to a *Trichophyton*, and gives rise to a Trichophyton eruption.

The genera of Gymnoascees containing human parasitic species are the following : (1) *Microsporon ;* (2) *Trichophyton ;* (3) *Epidermophyton ;* (4) *Endodermophyton ;* (5) *Achorion ;* (6) *Oospora ;* (7) *Montoyella.*

Genus Microsporon Gruby 1843.

Mostly parasitic in the hairs ; mycelial spores are roundish, small (2 to 3 μ), and irregularly arranged in a mosaic-like way. Cultivation fairly easy ; reproduction by chlamydospores, conidia, and septated and unseptated spindles.

Microsporon audouini Gruby 1843.

This parasite was described by Gruby in 1843, but his investigation was forgotten, till Sabouraud, in his classical researches on ringworm in 1892, demonstrated the plurality of the species of the fungi found in this affection, and showed that a form of tinea capitis was due to the microsporon described by Gruby.

Parasitic Life.—Around the affected hairs the fungus forms by means of its mycelial spores a white opaque sheath, extending 2 or 3 millimetres above the opening of the follicle to the hair bulb. The sheath is composed of a mosaic of small, roundish, or polyhedral spores, the diameter of which varies between 2 and 3 μ. In the interior of the hair a few mycelial filaments of the fungus may be observed. The fungus very seldom attacks glabrous parts of the body.

Saprophytic Life.—Cultures.—*Microsporon audouini* grows well on Sabouraud's maltose agar and other media. The rate of growing is very slow. In maltose agar the growth becomes evident about a week after inoculation under the appearance of a plaque, beneath the surface, of a so-called ' satiny aspect.' In a few days more aerial hyphæ develop, extending above the surface. When the development is complete—generally this takes about six to eight weeks—the growth is roundish, and presents often a central knob, and some concentric rings of a whitish, greyish colour. The cultural characters, however, are variable ; pleiomorphism is of common occurrence. The cultural characters have been thoroughly investigated by Sabouraud, Fox and Blaxal, Bodin, and others. The fungus very slowly liquefies gelatine ; on potatoes it produces a brownish discoloration, compared by Sabouraud to the colour of dried blood.

Reproduction.—This takes place—

1. By sprouts from the mycelial tubes.
2. By small terminal and lateral conidia.
3. By large unilocular or multilocular spindle conidia. These spindles are large structures 30 to 60 μ in length, and 15 to 18 μ in breadth. They may be septated or non-septated.
4. By formation of chlamydospores.

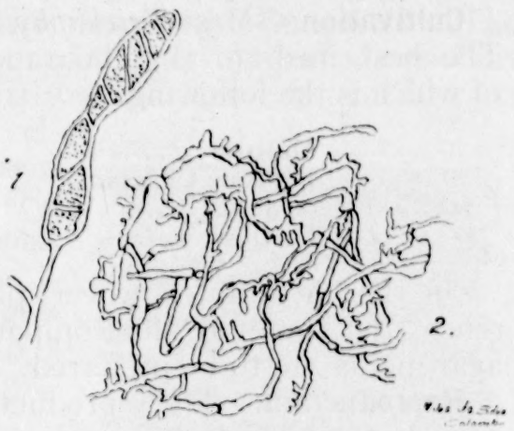

FIG. 271.—MICROSPORON.
(From cultures.)
1, Septated spindle body; 2, mycelium.

Pathogenesis.—*Microsporon audouini* causes the most obstinate form of tinea capitis. The patches affected are often large, scaly, and present stumps, provided with an opaque whitish sheath. It seldom attacks glabrous parts of the body. *M. audouini* is extremely common in England; rare in the South of Europe (Italy); extremely rare in the tropics. We have never seen cases of ring-worm due to *M. audouini* in Equatorial Africa or Ceylon, but a few cases have been described in Brazil and Madagascar.

Varieties of Microsporon audouini.—*M. audouini* seems to live only on the human subject, but closely allied varieties have been found by Fox in cats, by Bodin in dogs, by Bodin, Fox, and others in horses. These varieties may affect man. Bodin and other authors have described two of these varieties as different species under the name of *Microsporon equinum* Bodin and *M. caninum* Bodin, seu *M. lanosum* Sabouraud.

Genus Trichophyton Malmsten 1848.

In contrast to the genus *Microsporon*, the mycelial spores are large (4 to 7 μ). Hairy and non-hairy parts of the body may be attacked. In cultures the conidia are roundish, and often supported by short sterigmata.

General Considerations.—During their parasitic life the species of the genus *Trichophyton* vegetate according to two types: (1) Mycelial filaments; (2) mycelial spores.

The mycelial filaments consist of long cylindrical cells, separated by septa. The so-called mycelial spores are simply a modification of the mycelial filaments, due to the septa being much closer, so that the cells limited by them are almost as broad as they are long. The term 'mycelial spores' is incorrect, as they are not organs of reproduction, but only vegetative organs.

When the shape of these mycelial spores or sporulating mycelia is roundish or oval, the filament takes a moniliform appearance.

Moreover, these cells are easily dissociated. Such type is called 'fragile mycelium.' To this type belongs, for instance, *Trichophyton sabouraudi* R. Blanchard.

When the mycelial spores are square, the filament straight, and its articles long, the mycelium is called 'resistant.' This type is observed, for example, in *Trichophyton tonsurans* Malmsten.

Cultivation.—Most *Trichophytons* can be cultivated, some cannot. The best medium is Sabouraud's maltose agar, the composition of which is the following :

Maltose	4 grammes.
Peptone Chassaing	1 gramme.
Agar	1·50 grammes.
Distilled water	100 c.c.

On this medium, however, pleiomorphism is of frequent occurrence, and therefore, for comparative studies, cultures on ordinary agar media are to be preferred.

Reproduction.—The reproduction takes place by—

1. Lateral and terminal conidia, often suported by short sterigmata.
2. Chlamydospores.
3. Large terminal septated and unseptated spindles.

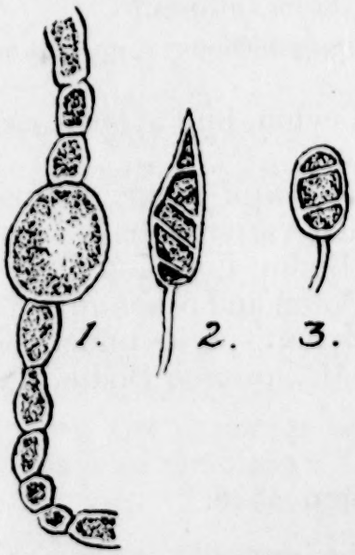

FIG. 272.—TRICHOPHYTON. (Preparation from cultures. After Bodin.)

1, Chlamydospore; 2 and 3, septated spindle bodies.

Classification. — *Trichophytons* can be divided into the following groups :

I. ENDOTHRIX.—The fungus develops in the interior of the hair ; does not cause suppuration ; of human origin only.

The species of *Trichophytons* of the type Endothrix are *Trichophyton tonsurans, T. sabouraudi, T. violaceum, T. foxi.*

II. ECTOTHRIX AND ENDO-ECTOTHRIX.—The fungus is present only on the surface of the hair, or both on the surface and in the interior ; often pyogenic ; of animal origin.

The species of the group Ectothrix and Endo-Ectothrix are : *T. mentagrophytes, T. depilans, T. equinum, T. felineum, T. megnini, T. verrucosum, T. ochraceum, T. album.*

III. TROPICAL TRICHOPHYTONS.—The fungi do not attack the hair or hair-follicles ; do not cause suppuration.

The species constituting the third group are : *T. albiscicans, T. blanchardi, T. ceylonense, T. macfadieni.* It is to be noted that in the tropics also *Trichophytons* of the Endothrix and Ecto- and Endo-ectothrix type are often found.

Trichophyton tonsurans Malmsten 1845.

Synonyms.—*Trichomyces tonsurans* Malmsten 1845, *Oidium tonsurans* Zopf 1890, *T. megalosporum endothrix* Sabouraud 1894, *T. crateriforme* Bodin 1902.

Causes the so-called '*black-dotted*' ringworm; somewhat rare in England; very common in hot climates; type Endothrix. The mycelial cells are large (4 to 5 μ), quadrangular (so-called resistant mycelium type). Grows well on maltose agar and other media; on maltose agar colonies are white or yellowish, often crateriform, and present a velvety surface at first, later powdery. In hanging-drop cultivations spore-bearing fructifications can be seen.

T. tonsurans, besides producing a type of tinea capitis, produces, also, a form of tinea corporis.

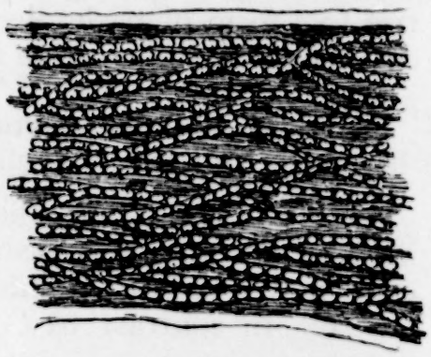

FIG. 273.—TRICHOPHYTON TONSURANS MALMSTEN.
(Preparation of a hair in liquor potassæ. After Sabouraud.)

Trichophyton sabouraudi R. Blanchard 1895.

Synonym.—*Trichophyton acuminatum* Bodin 1902.

This is of the type Endothrix. Mycelial threads have a moniliform appearance, and their articles become easily dissociated (so-called fragile mycelium). Grows well on maltose agar, giving rise to conical white colonies; often acuminate with central plumes, and occasionally may present yellowish or pinkish rings. In hanging-drop cultures aerial filaments with lateral spores are seen.

T. sabouraudi causes a form of tinea capitis called by Sabouraud 'tondante peladoide.' It may cause also a variety of tinea circinata.

Trichophyton violaceum Bodin 1902.

Discovered by Sabouraud in a case of tinea barbæ; belongs to the type Endothrix. The colonies on maltose agar are at first of a light brownish colour, and become violet later on. This species is common in Italy. It is occasionally found in the tropics.

Trichophyton flavum Fox 1908.

Described by Colcott Fox in some cases of tinea capitis, Endothrix type. Grows easily on various sugar media, its colonies being characterized by a central reddish nodule, which later becomes crateriform assuming a speckled appearance. The rest of the culture has a delicate but distinct primrose colour.

Trichophyton mentagrophytes Robin 1853.

Synonyms.—*Microsporon mentagrophytes* Robin 1853, *Sporotrichum mentagrophytes* Saccardo 1886.

Endo-ectothrix, mycelial spores being mostly situated outside the cuticle of the hair, while a few are found in the interior. The spores are of very unequal size (2 to 11 μ). On maltose agar very large colonies, of a white colour, appear with surface often presenting radial furrows. This *Trichophyton* is of animal origin (horses, cows, dogs, and perhaps pigs and sheep); it is pyogenic in man, giving rise to a form of trichophytic sycosis, and also to a variety of tinea corporis with suppurative foci.

Trichophyton depilans Mégnin 1879.

Synonym.—*T. flavum* Bodin 1902.

Endo-ectothrix; mycelial spores oval (5 to 11 μ); colonies on maltose agar of a yellowish colour; is parasitic in the horse and the calf; may occasionally infect man, giving rise to a variety of tinea barbæ. In contrast to *T. mentagrophytes*, this *Trichophyton* is not pyogenic.

Trichophyton equinum Gedoelst 1902.

Endo-ectothrix; mycelial spores oval, 4 to 6 μ in length; on maltose agar white orbicular colonies appear; and later the portion of the colony which is in contact with the medium becomes yellowish, and afterwards dark red. This *Trichophyton* is parasitic of the horse, and may attack man; is not pyogenic.

Trichophyton felineum R. Blanchard 1895.

Ectothrix; fragile mycelium; parasitic on cats, and also on dogs, horses, calves; may infect man, giving rise to a variety of tinea capitis or to a peculiar form of tinea corporis, described by Sabouraud under the name of 'circinate dysidriform trichophytosis.'

Trichophyton megnini R. Blanchard 1895.

Synonym.—*T. roseum* Bodin 1902, *T. rosaceum* Bodin 1902.

Endo-ectothrix; the mycelial spores found in the interior of the hairs are very large—8 to 9 μ in diameter; colonies on maltose agar at first white, later pinkish or of a deep rose colour; parasitic in fowls and pigeons; may infect man, causing a variety of tinea barbæ.

Trichophyton verrucosum Bodin 1895.

Endo-ectothrix. Though this fungus produces typical trichophytic lesions, its cultural characters are somewhat similar to those of an *Achorion*—grey acuminate cultures with irregular verrucose surface. It is found parasitic on the donkey. The same or similar species are found parasitic on the horse and on some birds. All these so-called faviform *Trichophytons* may occasionally infect man.

Trichophyton ochraceum Sabouraud 1907.

Type Ectothrix, of animal origin; cultures somewhat similar to favus. On maltose agar the colonies are characterized by a yellow ochre knob. On ordinary agar the surface of the colonies is cerebriform. Optimum temperature, 25° C. It is easily inoculated in guinea-pigs.

Trichophyton album Sabouraud 1907.

The cultures are extremely like favus, but are generally more deeply umbellicated and more regularly folded. Optimum temperature, 25° C. Can be inoculated in guinea-pigs.

Trichophyton albiscicans Nieuwenhuis 1907.

Found in tinea albigena. In preparations from scrapings the spores are very rare (4 to 5 μ in diameter). Growth on maltose agar very slow; colonies whitish, with a powdery surface.

Trichophyton macfadyeni Castellani 1905.

Synonym. — *Microsporon macfadyeni* 1905.

Found in tinea alba; mycelial threads slender (2 to 3 μ in breadth); spores oval, 3 to 3·5 μ maximum diameter. Grows with great difficulty.

FIG. 274.—TRYCHOPHYTON MACFADYENI.
(Stained with fuchsin.)

Trichophyton blanchardi Castellani 1908.

Synonym.—*T. sabouraudi* Castellani 1905.

Found in a form of tropical trichophytosis, described by Sabouraud. Mycelial tubes do not show a double contour, are often bent; spores roundish, of various size; cannot be grown.

Trichophyton ceylonense Castellani 1908.

Found in tinea nigrocircinata; spores rare, roundish, 4 to 5 μ in diameter; mycelium regular, with a double contour. The fungus cannot be grown.

Genus Epidermophyton Sabouraud 1907.

The fungi of this genus grow superficially on the human skin without invading the hair follicles; do not produce suppuration. The cultures often undergo rapid degenerative changes. Three species: *E. cruris*, *E. perneti*, *E. rubrum*.

Epidermophyton cruris Castellani 1905.

Synonyms.—*Epidermophyton inguinalis* Sabouraud 1907, *T. castellanii* Brook 1908, *T. cruris* Castellani 1905.

Found in most cases of tinea cruris, or dhobie itch; does not

invade the hair follicles. In scrapings from the affected regions the mycelial tubes are generally straight, and often show a double contour. In old cases banana-shaped form and other degenerative forms are present. The fungus grows on maltose agar very slowly; colonies orbicular-shaped or acuminate, of a greyish-yellow colour; later they become greenish white. The fungus has no pyogenic properties.

Epidermophyton perneti Castellani 1907.

Synonyms.—*T. perneti* Castellani 1907.

Found in some cases of tinea cruris; very similar to *T. cruris*; the growth, however, is much more rapid, and the cultures present a delicate pinkish colour, which is lost in subcultures.

Epidermophyton rubrum Castellani 1909.

Found in some cases of dhobie itch. On Sabouraud and glucose agars the growth is of a deep red colour; not lost in subcultures.

Genus Endodermophyton Castellani 1909.

The fungi belonging to this genus are characterized by their growing between the superficial and deep strata of the epidermis forming an interlacing felt of mycelia, which detaches the horny and granular layers from the rete Malpighi. Do not invade the hair follicles; do not cause suppuration. So far have not been cultivated.

Endodermophyton concentricum Blanchard 1901.

Synonyms.—*T. mansoni* Castellani 1905, *Aspergillus tokelaui* Wehmer 1907.

Causes tinea imbricata. Fungus very abundant in the scales; mycelial articles straight, regular, 3 to 4 μ in breadth, spores rather large (4 to 5 μ), roundish or oval. According to Nieuwenhuis, the fungus can be cultivated, and gives rise to crateriform, dark-coloured colonies. We have been unable to confirm Nieuwenhuis's results as regards cultivation.

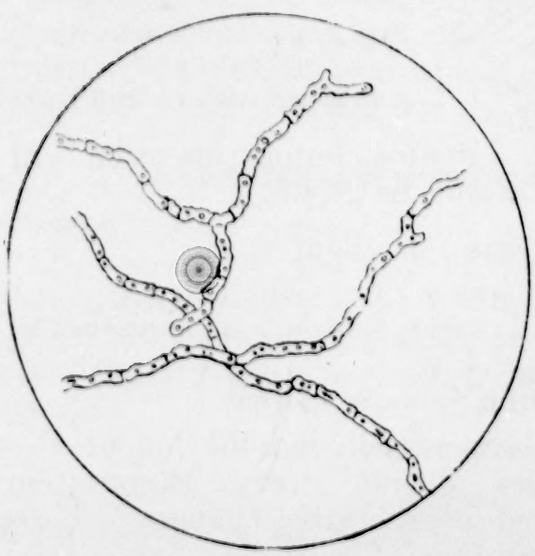

FIG. 275.—ENDODERMOPHYTON FOUND IN TINEA INTERSECTA.

Endodermophyton castellanii Perry 1907.

Causes a tropical dermatomycosis called tinea intersecta. In the scales the mycelium is fairly abundant, but free spores are extremely rare or absent; mycelial threads are straight, and have a double contour; breadth 3 to $3\frac{1}{2}$ μ; mycelium may ramify; attempts at cultivation have so far failed.

Genus Achorion Lebert 1845.

During parasitic life the mycelial segments are much longer than in the genera *Trichophyton* and *Microsporon*, and form the well-known sulphur-coloured *scutula*. In cultures on solid media, often disc-like colonies somewhat resembling scutula arise; gelatine is liquefied fairly rapidly.

Achorion schœnleini Lebert 1845.

Synonyms.—*Oidium schœnleini* Lebert 1845, *O. porriginis* Montague, *Oospora porriginis* Saccardo 1886.

Causes the well-known affection called *favus*, which is characterized by the presence of peculiar disc-shaped crusts called *scutula*, of a yellow colour, and emitting an offensive odour compared to the smell of mice's urine.

The fungus may infect the hairs or glabrous parts of the body; it may attack the nails. In the hairs the mycelium is very abundant, the segments being comparatively long.

Sometimes the mycelial threads divide into three or four branches, each of which terminates in a single row of roundish spores. This is known as *favic tarsus*.

Cultures.—*Achorion schœnleini* grows very slowly on maltose agar. The colonies are at first whitish and roundish, later may become brownish, and, apart from the colour, closely resemble the scutula. Gelatine is liquefied in between three to four days, while the *Trichophytons* take fifteen to twenty days.

FIG. 276.—SO-CALLED YELLOW BODIES IN CULTURES OF ACHORION SCHŒNLEINI LEBERT.

(After Bodin.)

Reproduction.—This takes place—

1. By endoconidia and external lateral conidia.
2. By sprouting.
3. By elongated fusiform structures analogous to the so-called 'spindles' of the *Trichophytons* and *Microsporons*, only slenderer and not septate. These formations are called by the French authors *chandeliers faviques*, on account of their shape somewhat resembling a candlestick.
4. By so-called 'favus claviform bodies' or 'yellow bodies,' which are claviform structures 8 to 15 μ in diameter, showing a double contour, and containing a granular substance. These structures should probably be considered to be chlamydospores.

Sabouraud admits only one species of *Achorion*, other authors several. Neebe and Unna have described as many as nine: *Achorion cysticum*, *A. tarsiferon*, *A. moniliforme*, *A. demergens*, *A. akromegalicum*, *A. dikroon*, *A. radians*, *A. euthythrix*, *A. atacton*.

In the lower animals—mouse and cat—very similar species to *A. schœnleini* have been found. The variety found in the mouse

has been described by Zopf 1890 under the name of *A. quinkenaum*, and may infect man, as observed by Bodin, Admason, and others. It grows readily on maltose agar producing white downy colonies.

In the dog and in fowls diseases closely resembling human favus are observed, but they are due to fungi not belonging to the genus *Achorion*. The favus of dogs is due to a fungus of the genus *Oospora—O. canina* Costantin and Sabrazès 1893; the favus of fowls is caused by a *Lophophyton—L. gallinæ* Mégnin 1881.

Achorion gypseum Bodin 1907.

Described by Bodin in 1907 in a few cases of favus. This fungus shows transition characters between the genus *Achorion* and the genus *Microsporon*. In cultures it presents all the principal characters of a microsporon, but causes in man classical favus lesions. It is easily inoculated in guinea-pigs and mice, in which it produces typical scutula.

Genus Oospora.

Mycelium very slender; some mycelial threads abstrict at their extremities chains of spores.

Oospora tozenri Nicolle and Pinoy 1908.

Causes a variety of black mycetoma in Algeria and Tunis. Masses of the fungus give rise to small, hard black grains. During parasitic life the mycelium is septate, ramified, 1 to 4 μ in breadth; chlamydospores present. On maltose agar the fungus grows best at 35° C., giving rise to whitish colonies, while the medium becomes black. Structures similar to the so-called 'favus claviform bodies' have been observed; some hyphæ consist of strings of small cylindrical elements 4 μ in length and 2 μ in breadth.

Oospora canina Costantin-Sabrazès 1893.

Causes the favus of dogs; may be transmitted to man, but seldom gives rise to typical favus lesions. Only mode of reproduction so far known is by chains of conidia.

Oospora lingualis Guéguen 1909.

Thin mycelial tubes, articles of which are easily dissociated. In cultures chlamydospores are present and structures resembling the claviform bodies of achorion observed in cases of *Lingua pilosa*.

Genus Montoyella Castellani 1907.

Two kinds of mycelial threads: some slender, ramified, septate; others much thicker, having numerous intermediate chlamydospores. From the thicker filaments delicate hyphæ take origin which terminate into large pear-shaped or globular conidia.

Montoyella nigra Castellani 1907.

Colonies on maltose agar black. If glycerine agar is used, the medium takes a black colour. This species, discovered by Montoya, is common in black pinta.

Montoyella bodini Castellani 1907.

Found by Bodin in a case of red pinta ; colonies whitish or greyish.

SUBORDER CARPOASCEES.

This suborder of Ascomycetes is characterized by the fact that the *asci* are not free, and do not spring directly from the mycelium. They are produced in special fructifications.

Of the suborder Carpoascees, only two families, the *Perisporiaceæ* and the *Pyrenomycetes*, contain species parasitic on man.

FAMILY PERISPORIACEÆ.

The ascagenous hyphæ are enclosed by a compact envelope of interwoven, sterile filaments. On the rupture or disintegration of this envelope (perithecium) the ascospores become free. In many cases reproduction takes place also by means of conidia.

TABLE SHOWING PERISPORIACEÆ PARASITIC IN MAN.

Family.	Genus.	Species.
Perisporiaceæ	Penicillium	P. crustaceum.
		P. minimum.
		P. barbæ.
		P. bouffardi.
		P. montoyai.
		P. pruriosum.
	Aspergillus	A. fumigatus.
		A. bronchialis.
		A. glaucus.
		A. nigrescens.
		A. repens.
		A. malignus.
		A. flavus.
		A. nidulans.
		A. niger.
		A. pictor.
		A. barbæ.
		A. bouffardi.
		A. fontoynonti.

Genus Penicillium Link 1809.

The whole fruit-bearing hypha with its sterigmata and conidia resembles a hair-pencil, hence the name of the genus (*Penicillium* = hair-pencil). The conidiophore hypha shows verticillate branches, which give rise to slender fusiform formations (sterigmata) abstricting chains of conidia.

Penicillium crustaceum Link. 1763.

Synonyms.—*Mucor crustaceus albus* Link. 1763, *Monilia digitata* Persoon, *Penicillium glaucum* Link. 1809, *P. expansum* Link.

An extremely common saprophyte found on bread, cheese, fruits, and various organic substances in a state of decomposition.

The conidia are spherical or slightly elliptical; maximum diameter 4 μ. This fungus grows well at any temperature between 2° C. and 35° C., and is very resistant. It has been found in man by Maggiora and Gradenigo in two cases of otitis media. Heinhorn has observed it in the vomiting of four cases of acid dyspepsia.

Wertheim has observed that the intravenous inoculation of *P. crustaceum* is pathogenic to rabbits, dogs, and lambs.

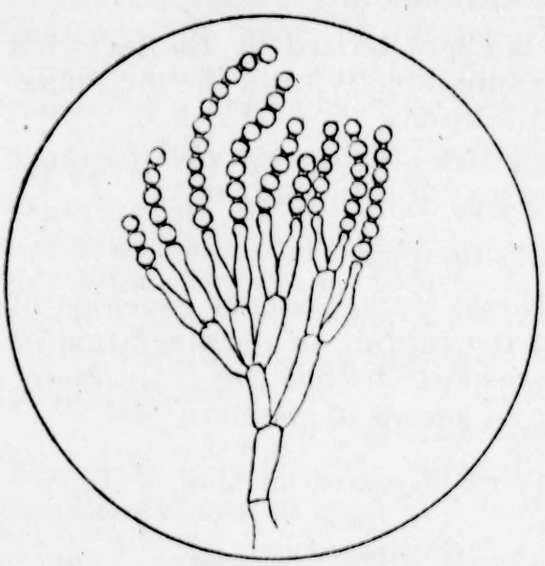

FIG. 277.—PENICILLIUM FRUCTIFICATION.

Penicillium minimum
Siebenmann 1889.

Found in a case of acute otitis by Siebenmann. Conidia are brownish-black, smaller than in *P. crustaceum*.

Penicillium montoyai
Castellani 1907.

Conidia roundish or slightly oval, smooth, 3 to $4\frac{1}{2}$ μ in diameter. Grows well on maltose agar and ordinary agar; cultures of dark greyish colour. Discovered by Montoya in cases of pinta, of the greyish-violet variety. Similar species, not yet well defined, are found in other varieties of pinta.

Penicillium barbæ Castellani 1907.

Found by us growing on the hairs of the beard of natives of Equatorial Africa and in natives of Ceylon.

Penicillium pruriosum Salisbury.

Doubtful species found by Salisbury in the vaginal mucus of a woman suffering from intense vaginal pruritus.

Penicillium bouffardi Brumpt 1906.

Found by Bouffard in a mycetoma with red granules; grows well on sugar media, giving rise to red colonies.

Genus Aspergillus Micheli 1725.

The conidiophore hyphæ are not ramified, and terminate into ovoid or roundish formations, which support numerous claviform elements (*sterigmata*), each of which gives rise to a chain of roundish conidia.

Aspergilli are generally saprophytes, but they may become parasites. They are easily grown on acid media, liquid or solid,

and also on alkaline media. When growing as parasites in animal tissues, they very often lose their typical morphological characters, and appear as yeast-like, oidium-like, and actinomycotic-like forms.

Aspergillus fumigatus Fresenius 1775.

The commonest *Aspergillus*, very often found on various cereals straw, hay, etc. On solid media it produces a brownish or greenish-brown, culture. The mycelial filaments are more or less ramified, the breadth varying between 2 and 3 μ. The conidiophore hyphæ are much thicker than the mycelial tubes, being about 5 μ in breadth. The sterigmata are 6 μ long; the conidia are roundish, 2·5 to 3 μ in diameter.

This *Aspergillus* is the species most frequently found in man, giving rise to an aspergillosis of various organs. The spores are very resistant. Perchloride of mercury is the antiseptic which has the greatest destructive action on these spores.

FIG. 278.—ASPERGILLUS FUMIGATUS.

Aspergillus niger von Tieghem 1867.

Synonyms.—*Sterigmatocystis antacustica* Cramer 1869, *Eurotium nigrum* De Bary 1870, *Monilia pulla* Persoon, *Aspergillus nigricans* Wreden 1874.

Erected conidiophores; hyphæ more than 1 millimetre in length. Conidia globular, 315 to 415 μ in diameter, provided with a membrane of a brownish-violet colour. Commonly found in decaying organic substances. It was first observed in man by Cramer, who observed it in the ear of a deaf patient. Later it was observed by Furbringer and others in mycotic affections of the lungs.

Aspergillus barbæ Castellani 1907.

Found by us in natives of Uganda, and in natives of Ceylon. Conidia spherical, 4 to 5 μ, of a brownish colour.

Aspergillus fontoynonti Guéguen 1909.

Found in cases of juxta-articular nodes by Fontoynont and Carougean. Small size, 150 to 200 μ; conidiophores, 14 to 18 μ in diameter; conidia oval, 3 to 5 by 4 to 6 μ.

Aspergillus nigrescens Robin.

Doubtful species, which, according to Wienfeld, causes a faviform eruption.

Aspergillus flavus De Bary 1870.

Synonyms.—*Monilia aurea* Gmelin 1791, *Eurotium flavum* De Bary 1870, *Aspergillus flavescens* Wreden 1874.

Conidiophore hyphæ terminate in a roundish formation of a gold-yellow colour. The conidia are dark yellow, roundish, 5 to 7 μ in diameter, with a surface showing numerous small mammillar prominences. Found by several authors (Wreden, Siebenmann, etc.) in the ear.

Aspergillus bronchialis Blumentritt 1901.

Mycelium of a white colour, much ramified; conidiophore hyphæ are 6·2 to 12·6 μ. Conidia roundish, with a smooth surface, of a greyish-greenish colour. This *Aspergillus* was found by Chiari in the bronchi of a patient who had died of diabetes. It has not yet been found as a saprophyte.

Aspergillus malignus Lindt 1889.

Doubtful species found in the ear by Lindt, according to whom it was very pathogenic for rabbits.

Aspergillus repens De Bary 1870.

Synonym.—*Eurotium repens* De Bary 1870.

Mycelium of a yellowish-green colour. Conidia large—7 to 8·5 μ. Found by Siebenmann in the ear three times. Its pathogenic rôle is doubtful.

Aspergillus nidulans Eidam 1883.

Synonym.—*Sterigmatocystis nidulans* Eidam 1883.

Mycelium of a greenish colour. Conidiophores are erect, 0·5 to 0·8 millimetres in length. Presence of primary sterigmata supporting secondary sterigmata, each of which gives rise to a chain of conidia. Conidia small (3 μ in diameter), globular, of a greenish colour. This species is found living saprophytic in certain nests, hence the name *A. nidulans*. In man it has been found in several cases of otomycosis; Nicolle has found it, or a very similar species, in a case of mycetoma with white granules.

Aspergillus pictor R. Blanchard 1895.

Synonym.—*Trichophyton pictor* R. Blanchard 1895.

The term *Aspergillus* (*Trichophyton*) *pictor*, introduced by Blanchard in 1895, before the plurality of species of the fungi found in pinta was demonstrated, is now used to denote the species of *Aspergillus* which is found in the pure violet variety of pinta.

This fungus shows the typical morphological characters of the

genus *Aspergillus*. It grows easily in various sugar media. On maltose agar the growth has at first a whitish colour, which afterwards changes into greenish, to become violet or greenish with a violet tinge in a later period. The colour of the growth may vary according to the medium on which cultivation takes place. The conidiophores are comparatively thick; the conidia are globular, with a smooth surface.

Several other species of aspergillar and aspergillar-like fungi are found in pinta, but their botanical position has not yet been defined with certainty.

FIG. 279.—ASPERGILLUS FOUND IN PINTA.
(After Montoya y Florez.)

Aspergillus bouffardi Brumpt 1905.

Found by Bouffard in a case of black mycetoma and completely described by Brumpt. Mycelium whitish in some zones, dark brownish in others. Conidiophores erect, white, terminated in a claviform structure, bearing some short chains of roundish conidia. Chlamydospores present, 5 to 10 μ in diameter. Attempts at cultivation did not succeed.

Remarks on Aspergillomycoses.—These affections are common in man and the lower animals.

1. ASPERGILLOSIS OF THE LUNGS; ASPERGILLAR PSEUDO-TUBERCULOSIS; PNEUMOMYCOSIS OF ASPERGILLAR ORIGIN.—Aspergilli develop sometimes in the mucosa of the trachea, of bronchi, and even in the pulmonary alveoli, without giving rise to any pathogenic effect. In other cases the fungi induce pseudo-membranous and ulcerative lesions. A very serious affection is a form of pseudo-tuberculosis (*pseudo-tuberculosis aspergillina*) characterized by the presence of mycotic nodules in the lungs, liver, kidneys, and other organs. This affection, due to *A. fumigatus*, is very common in some parts of France among *pigeon-breeders* (*gaveurs de pigeons*). The same affection attacks the pigeons. The infection is probably caused by spores of *A. fumigatus* being present in the grains used for feeding the pigeons.

2. ASPERGILLOSIS OF THE EYE.—*A. fumigatus* has been found several times in ulcers of the cornea (keratomycosis aspergillina).

3. ASPERGILLOSIS OF THE EAR (OTOMYCOSIS ASPERGILLINA).—Various species of *Aspergillus* have been found in the ear. In some cases they may give rise to a serious otitis, deafness, and tinnitus. Aspergillosis of the ear is not rare in the tropics. Syringing with hydrogen peroxide two parts and alcohol one part is useful.

4. ASPERGILLOSIS OF THE NOSE.—*A. glaucus* and *A. fumigatus* have been found in the nasal cavities; the first apparently does not cause any disturbance. The second causes various inflammatory symptoms.

5. ASPERGILLOSIS OF WOUNDS AND ULCERS.—In wounds not properly treated, and in old ulcers, *Aspergilli* have been occasionally found.

6. ASPERGILLOSIS OF THE URETHRA.—In several cases a black urethral discharge has been observed, due to *A. niger*.

7. ASPERGILLOSIS OF THE SKIN.—Montoya's investigation has shown that several varieties of pinta are due to fungi of the genus *Aspergillus*. Another important tropical skin disease, Tinea imbricata, is, according to some observers (Tribondeau, Wehmer), due to an *Aspergillus—A. tokelau* Wehmer 1903. In our experience the fungus of *T. imbricata* never shows aspergillar fructifications, and cannot be considered to be an aspergillus.

Aspergilli may also cause some varieties of mycetoma.

FAMILY PYRENOMYCETES.

Ascomycetous fungi in which the asci are contained in a perithecium presenting an orifice at the apex for the escape of the spores. According to some authors, species of this family have been found parasitic in man. This is very doubtful, though Schubert states that he found in the nasal mucus of a patient an organism closely allied to *Botrytis bassiana*, which latter species, as is well known, causes the disease of silkworm called muscardin.

ORDER BASIDIOMYCETES.

Basidiomycetes have a septate mycelium, and are devoid of sexual reproduction. They reproduce by formation of basidia. Other accessory fructifications may be present—as, for example, chlamydospores. The basidia are of two principal types: (1) autobasidia; (2) protobasidia.

The autobasidia are large, unseptated cells, giving rise at their apices to four delicate sterigmata, each of which bears a spore.

The protobasidia are septated, and appear in two chief forms:

A. Septated into four cells, each giving rise to a spore from a lateral inserted sterigma.

B. Septated by walls intersecting at right angles, each cell ending in an elongated tubular sterigma.

Of the Basidiomycetes, one species (*Ustilago hypodytes*) of the family Ustilagineæ is of special importance, while two others (*U. carbo* and *Tilletia levis*) may produce otomycosis.

Ustilago hypodytes Schlecht.

The mycelium penetrates the stem and leaves of *Arundo donax* in some parts of Provence. After a time the mycelium produces innumerable so-called brand spores by a process of division of its profusely branched hyphæ. In this way the mycelium is transformed into a brown dark mass of spores.

These brand spores, as regards the mode of their formation, may be considered chlamydospores. The brand spores are resting spores; they are scattered by the wind, and after an interval of rest they germinate, producing conidiospores of a basidium-like type.

The spores of *U. hypodytes* are the cause, according to most authors, of a peculiar affection found among workers who have to do with the cutting, etc., of *A. donax*. This affection is called 'frienite,' or 'frien disease.' The patient complains of symptoms somewhat resembling hay-fever, sneezing, headache, etc., and, in addition, shows an erythematous eruption on the un-

covered part of the body, and often also on the genital organs, which may become greatly œdematous.

According to a few other observers, the cause of this peculiar disease is to be found, not in the spores of *Ustilago*, but in an insect—*Aclerda berlesei*—which often swarms on various canes. The workers, in manipulating the canes, squash some of these insects. The irritating juice exuding from the squashed insects produces a dermatitis of an erythematous type.

ORDER HYPHOMYCETES (MUCIDINEES OR FUNGI IMPERFECTI).

This order contains groups of very different fungi, the botanical position of which cannot be conclusively made out in the present state of our knowledge. For the classification of these fungi it is necessary to take into account, not only their morphological botanical characters, but also their biological characters and pathogenic properties.

The following genera of Hyphomycetes contains species parasitic in man : (1) *Discomyces* Rivolta 1878 ; (2) *Madurella* Brumpt 1905 ; (3) *Indiella* Brumpt 1905 ; (4) *Trichothecium* Link 1824 ; (5) *Monilia* Persoon 1801 ; (6) *Sporotrichum* Link 1809 ; (7) *Trichosporum* Behrend 1890 ; (8) *Microsporoïdes* Neveu-Lemaire 1906 ; (9) *Pityrosporum* Sabouraud ; (10) *Hemispora* Vuillemin 1906 ; (11) *Malassezia* Ch. Robini 1853 ; (12) *Foxia* Castellani 1908.

Genus Discomyces Rivolta 1870.

Some mycelial filaments terminate in club-like formations, and show a radial arrangement ; masses of mycelium give origin to peculiar granules or ' grains ' of various consistence and colour, according to the different species. These fungi are parasitic in man and lower animals, and may live as saprophytes or parasites on plants.

Discomyces bovis Harz 1877.

Synonyms.—*Actinomyces bovis* Harz 1877, *Discomyces bovis* Rivolta 1877, *Nocardia actinomyces* Toni and Trevisan 1889, *Streptothrix actinomyces* Rossi-Doria 1891, *Oospora bovis* Sauvageau and Radais 1892, *Actinomyces bovis sulphureus* Gasperini 1894, *Nocardia bovis* R. Blanchard 1895, *Streptothrix israeli* Kruse 1896, *Cladothrix actinomyces* Mace 1897, *Discomyces bovis* R. Blanchard 1900, *Streptothrix spitzi* Lignières and Spitz 1903.

This *Discomyces* is the cause of human and bovine actinomycosis, and of the actinomycotic mycetoma. The fungus lives parasitic in most tissues, in which it gives rise to degenerative and purulent changes. In the pus small, soft yellow granules—so-called ' sulphur grains '—are seen. These sulphur grains consist of masses of mycelium. At the periphery of the granule the threads are radially arranged, and their free extremities become club-like, 10 to 20 millimetres in length and 8 to 10 millimetres in breadth. These peculiar club-like formations had been considered by some authors to be degeneration forms of the fungus, but Brumpt has demonstrated that they are young active forms, and disappear in old granules.

Cultures.—The fungus grows easily on agar, glycerinated agar, gelatine, broth, potato, and other media. Optimum temperature,

35° to 37° C. On solid media the colonies develop fairly rapidly, and have a coarse granular appearance. The fungus is Gram-positive but not acid fast.

Saprophytic Life.—The fungus is often found as saprophytic on the spikelets of some cereals (*Phleum pratense* Linnæus, *Hordeum murinum* Linnæus, etc.).

Varieties.—Gasperini describes three varieties of *Discomyces bovis*—*D. bovis sulphureus*, *albus*, and *luteo-roseus*. Caminiti has described a variety which he thinks may be a new species.

Other authors have described as a separate species (*D. israeli*) a *Discomyces* found in several cases of human actinomycosis. According to Wright and the majority of authors, *D. israeli* is identical with *D. bovis*.

Discomyces försteri Cohn 1874.

Mycelial threads very slender, non-ramified, often terminating in a chain of rod-like or coccus-like elements. Masses of the fungus form some peculiar whitish bodies, which have been occasionally found in the lachrymal canals of man.

Discomyces rosenbachi Kruse 1896.

Synonym.—*Streptothrix rosenbachi* Kruse 1896.

Isolated by Rosenbach in a skin affection called by him 'erysipeloid.' Mycelial threads very slender; some terminate in club-like swellings. Can be cultivated on the ordinary media.

Discomyces asteroïdes Eppinger 1890.

Synonyms.—*Cladothrix asteroïdes* Eppinger 1890, *Streptothrix eppingeri* Rossi-Doria 1891, *Oospora asteroïdes* Sauvageau and Radais 1892, *Nocardia asteroïdes*. R. Blanchard 1895, *Discomyces freeri* Musgrave and Clegg 1907.

Found in mycetoma and in cases of abscess of the brain. Mycelial threads very slender (0·2 μ wide); the mycelial articles become easily dissociated, when they look bacillus-like. This fungus is easily cultivated on ordinary media; obligative aerobe. Inoculations in the rabbit and guinea-pigs produce a form of pseudo-tuberculosis.

Discomyces brasiliensis Lindenberg 1909.

Found by Lindenberg in a case of mycetoma of the leg. Small white-yellowish, soft, moriform granules (0·1 to 0·5 millimetre), consisting of very delicate ramified mycelial tubes (0·0521 μ in diameter). Easily cultivated. Pinkish growth on Sabouraud's medium.

Discomyces maduræ Vincent 1894.

Synonyms.—*Streptothrix maduræ* H. Vincent 1894, *Nocardia maduræ* R. Blanchard 1895.

It causes Vincent's white mycetoma, very commonly found in Africa and Asia. The 'grains' which are found in the pus of such

cases are soft, white, or slightly yellowish, and have a *mulberry-like* surface. At the periphery of the grains radiating filaments are found, but claviform swellings are usually absent ; mycelial threads are always very slender (1 to 1½ μ). The fungus can be grown on the ordinary media ; facultative aerobe. On glycerinated agar it forms discoid colonies, white in the centre and reddish at the periphery. In the cultures the mycelial threads are as slender as in the grains. Some of the mycelial threads have at their extremities short chains of small conidial elements. Gram-positive, but not acid fast.

It is to be noted that this fungus very rarely produces bone lesions. Most strains are inoculable into monkeys.

Genus **Madurella** Brumpt 1905.

One species only.

Madurella mycetoma Laveran 1902.

Synonym.—*Streptothrix mycetomi* Laveran 1902.

This causes a variety of mycetoma with black, irregular-shaped grains ; mycelial threads of a variable diameter (between 1 and 10 μ) ; septated, ramified ; secrete a dark substance. After some time the mycelial threads become organized into *sclerotia*, containing roundish bodies (8 to 10 μ in diameter), which are probably chlamydospores.

Genus **Indiella** Brumpt 1905.

White thallus vegetating in various animal tissues (bones, muscles, connective tissue) ; mycelial threads 1 to 5 μ wide, occasionally as much as 10 μ ; septated, ramified ; no secretion of pigment. These filaments, by massing together, form grains comparable to sclerotia containing chlamydospores.

Indiella mansoni Brumpt 1905.

White mycelium ; young filaments very slender (1½ to 2 μ) ; older ones thicker (3 to 5 μ wide). Presence of many chlamydospores, generally terminal. The grains or sclerotia are very small (0·2 to 0·25 millimetre in diameter), hard, white. This fungus gives rise to a variety of white mycetoma found in India.

Indiella reynieri Brumpt 1905.

The sclerotia or grains are characteristic ; small (less than 1 millimetre) ; white ; coiled up like the excrementa of earth-worms. This fungus causes a variety of white mycetoma.

Indiella somaliensis Brumpt 1905.

Mycelial threads extremely thin (0·5 μ) ; when old, often take a moniliform appearance ; numerous chlamydospores ; the grains, formed by dense felting of mycelial threads, are whitish or yellowish, small (about 1 millimetre), very hard. *I. somaliensis* cannot be grown. According to Brumpt, another *Discomyces*, easily grown, may be found living symbiotically in the tissues with *I. somaliensis*.

Genus Trichothecium Link 1824.

Fertile hyphæ are erect, grouped together, each terminating in an oval, pear-shaped, or globular conidium. The only species so far observed in man is *Trichothecium roseum.*

Trichothecium roseum Persoon 1801.

Synonyms.—*Trichoderma roseum* Persoon 1801, *Sporocephalum roseum* Persoon 1801, *Puccinia rosea* Corda 1837.

This species vegetates on decaying vegetable matter; the colour is at first white, then pinkish. Each fertile hypha terminates in a pear-shaped conidium, 10 to 20 μ in length and 8 to 12 μ in breadth.

This fungus has been found in a few cases of otomycosis.

Genus Monilia Persoon 1801.

Fertile hyphæ are erected, bearing at their extremities short chains of large roundish conidia.

Monilia candida Bonorden.

Commonly found vegetating in decomposing vegetable matter; occasionally seen parasitic in Mammalia, giving rise to white patches on the tongue and buccal mucosa, somewhat similar to human *thrush.* Once found in a child in some white patches present on the tongue. Mycelium 1 to 1½ μ in breadth; conidia roundish, smooth, 7 to 8 μ in diameter.

Monilia kochi Saccardo 1885.

Synonym.—*Rhodomyces erubescens* Aster 1900.

Morphologically similar to *M. candida*; grows well on sugar media, where it produces pinkish colonies; was observed by Wettstein in a case of chronic acid dyspepsia.

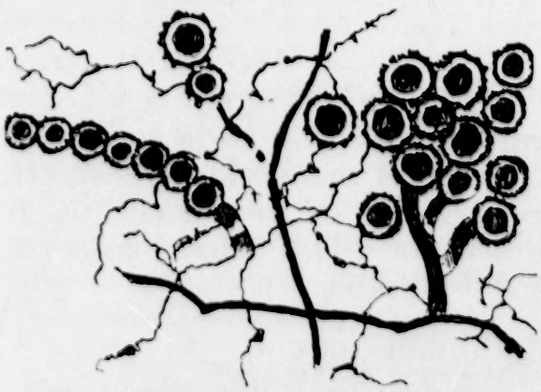

FIG. 280.—MONILIA MONTOYAI.
(After Montoya y Florez.)

Monilia montoyai Castellani 1907.

Discovered by Montoya in cases of white pinta. Some fertile hyphæ are much thicker than others; the spores are large, globular (5 to 7 μ), and contain a large nucleus. Grows well on sugar media, giving rise to white, creamy colonies which rapidly fuse together.

Genus Sporotrichum Link 1809.

During parasitic life the fungi of this genus appear as yeast-like cells. In cultures they show abundant septate, ramified mycelium, and oval or roundish spores. The dermatomycoses caused by these fungi are called sporothricoses; they are often characterized by the presence of gumma-like swellings.

Sporotrichum schenki Hektoen and Perkins 1900.

Easily grown on glucose and other sugar media. Colonies brownish, with an irregular surface ; abundant mycelium ; spores oval, 3 to 5 μ in length ; pathogenic to mice.

Sporotrichum beurmanni Matruchot and Ramond 1905.

Easily cultivated on sugar media ; colonies at first are often whitish, soon to become brownish, and even black ; mycelial threads slender, frequently less than 2 μ wide ; very much ramified ; spores ovoid (3 to 5 μ long and 2 to 4 μ wide) ; very pathogenic for mice.

Sporotrichum indicum Castellani 1908.

Found by Castellani in two cases of tropical sporotrichosis. Closely resembles the *S. beurmanni;* the mycelial threads are somewhat larger, between 2 and 3 μ wide ; spores roundish (3 to 5 μ in diameter) or oval (4 to 5 μ long and 3 to 4 μ in breadth). Colonies on maltose agar may be of various colours—greyish, light brownish, dark brownish, black.

Genus Trichosporum Behrend 1890.

These fungi live parasitic on the surface of the hairs, but do not penetrate into their interior ; during their parasitic life they vegetate under the form of large oval or roundish elements. Saprophytically (cultures) they vegetate forming mycelial threads and spores.

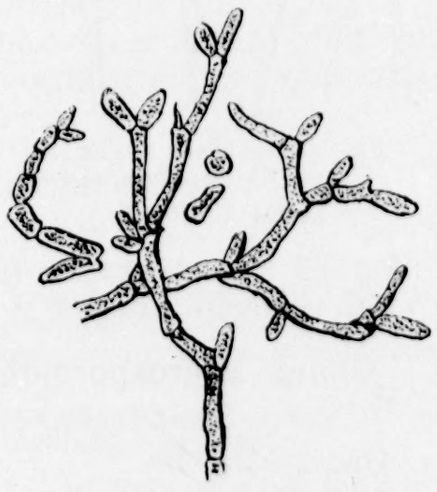

FIG. 281.—TRICHOSPORUM.
(After Vuillemin.)

Trichosporum giganteum Behrend 1890.

This is the cause of *piedra* of Columbia ; develops on the surface of the hair under the form of large polyhedric cells 12 to 15 μ in diameter. Masses of the fungus form hard nodules along the hair. The fungus is easily grown on various media. In cultures the mycelial threads are septated, cylindrical, between 1 and 4 μ wide. The spores are of various dimensions, between 2 and 12 μ.

Trichosporum beigeli Rabenhorst 1867.

Synonyms.—*Pleurococcus beigeli* Rabenhorst 1847, *Sclerotium beigelianum* Hallier 1868, *Hyalococcus beigelii* Schroeter 1886, *Chlamydotomus beigelii* Trevisan 1889, *Micrococcus beigelii* Migula 1900, *Trichosporum beigelii* Vuillemin 1901.

This fungus has been found in Europe several times in nodosities of the hairs of the moustache. It lives parasitically under the form of ovoid or polyhedral elements massed together on the surface of the hair. These ovoid or polyhedral elements are much smaller

than those of the preceding species, their maximum diameter varying between 3 and 4 μ. It is easily cultivated on ordinary media. In cultures mycelial threads are found, septate, slender (1·75 to 2 μ). In old cultures chlamydospores are to be seen.

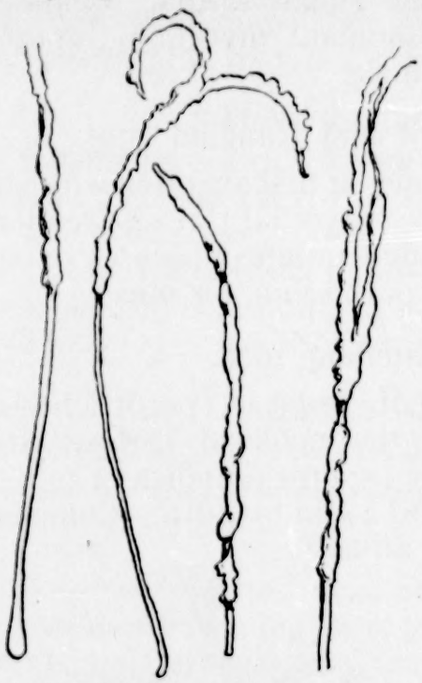

FIG. 282.—HAIR AFFECTED WITH TRICHOSPOROSIS. (After Vuillemin.)

Trichosporum ovoides Behrend 1890.

Found by Behrend in the nodosities present on the moustache of a European patient; vegetates parasitically on the surface of the hair under the form of ovoid elements; 3 to 4 μ long and $1\frac{1}{2}$ to $2\frac{1}{2}$ μ wide. Grows easily on culture media; on potatoes the colonies are white, while the medium takes a brownish-black colour.

Trichosporum ovale Unna 1896.

Found by Unna in the nodosities present on the moustache of a European patient. Very similar to *T. ovoïdes;* in cultures, however, the mycelial threads are often corkscrew-like, and the spores have thick walls. On potatoes the colonies are white-yellowish, and the substratum takes a brownish-black colour.

Genus Microsporoides

Neveu-Lemaire 1906.

One species only.

Microsporoides minutissimus

Burchardt 1859.

Synonyms. — *Microsporum minutissimum* Burchardt 1859, *M. gracile* Balzer 1883, *Sporotrichum minutissimum* Saccardo 1886, *Discomyces minutissimus* P. Verdun 1907.

Mycelial threads extremely thin (0·6 μ); seldom ramified. The mycelial segments get easily dissociated, and have then the appearance of bacilli. Has not yet been cultivated; is the cause of erythrasma.

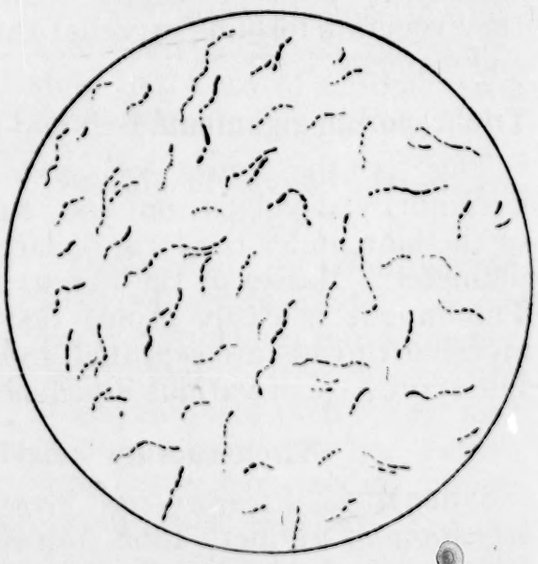

FIG. 283.—MICROSPOROÏDES MINUTISSIMUS BURCHARDT. (After Neven-Lemaire.)

Genus Pityrosporum Sabouraud 1895.

Oval or roundish cells, somewhat yeast-like; no mycelium; cannot be grown artificially.

Pityrosporum ovale Bizzozzero 1882

Synonyms.—*Saccharomyces ovalis* Bizzozzero 1882, *Pityrosporum malassezi* Sabouraud 1895. Usual term: bottle bacillus of Malassez.

This organism was first described by Bizzozzero, who considered it to be a *Saccharomyces*. Malassez and Sabouraud associated this organism with the etiology of pityriasis simplex capitis and pityriasis alba.

Its shape somewhat resembles a budding yeast or a flask. The size varies greatly; the maximum diameter of some individuals may be as much as 10 to 15 μ, but much smaller forms (3 to 5 μ) are found.

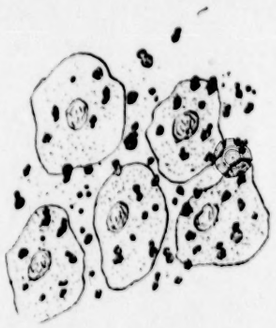

FIG. 284.—PITYROSPORUM OVALE. (After Sabouraud.)

Pityrosporum cantliei Castellani 1908.

Synonym.—*Saccharomyces cantliei* Castellani 1908.

Somewhat similar to *Pityrosporum ovale*, but the cells are generally roundish and on the average larger (5 to 16 μ). Probably the cause of a variety of seborrhœa of the scalp occasionally met with in children in the tropics.

Genus Hemispora Vuillemin 1906.

One species.*

Found by Vuillemin parasitic on *Aspergillus repens*, forming white discs (0·5 to 2·5 millimetres in diameter), which present, in relief, stellar or marguerite-like brown structures. Composed of conidiophores, each conidiophore terminates in a vesicle-like structure (protoconidium), which later divides into several spore-like segments (dentero conidia). Can easily be cultivated on artificial media, the growth being cerebriform, and not characteristic. This parasite has been observed in man in gumma-like swellings.

Genus Malassezia Ch. Robin 1853.

Mycelium of various shape and size; non-ramified; spores collected in bunches like grape-bunches; only the parasitic stage known.

Malassezia furfur Ch. Robin 1853.

Synonyms.—*Microsporon furfur* Ch. Robin 1853, *Sporotrichum furfur* Saccardo 1886, *Malassezia furfur* Baillon 1889, *Oidium furfur* Zopf 1890, *O. subtile* Kotliar 1892.

Mycelium abundant, septate, non-ramified; some mycelial threads are much larger than others; the breadth varies between 3 and 4 μ. The spores are roundish (3 to 5 μ in diameter), and run into clusters.

Attempts at cultivation have failed. It is the cause of pityriasis versicolor.

Malassezia tropica Castellani 1905.

Synonym.—*Microsporon tropicum* Castellani 1905.

Mycelial threads generally thick (3 to 5 μ wide), with numerous swellings, constrictions, and other irregularities of shape; spores

* *Hemispora stellata* Vuillemin 1906.

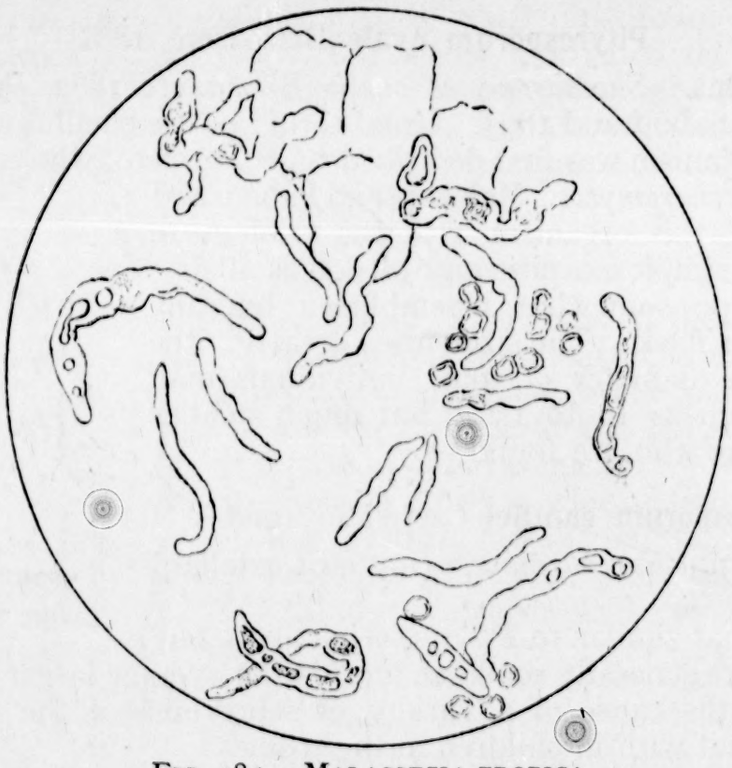

FIG. 285.—MALASSEZIA TROPICA.
(From a fresh preparation in liquor potassæ. Old case.)

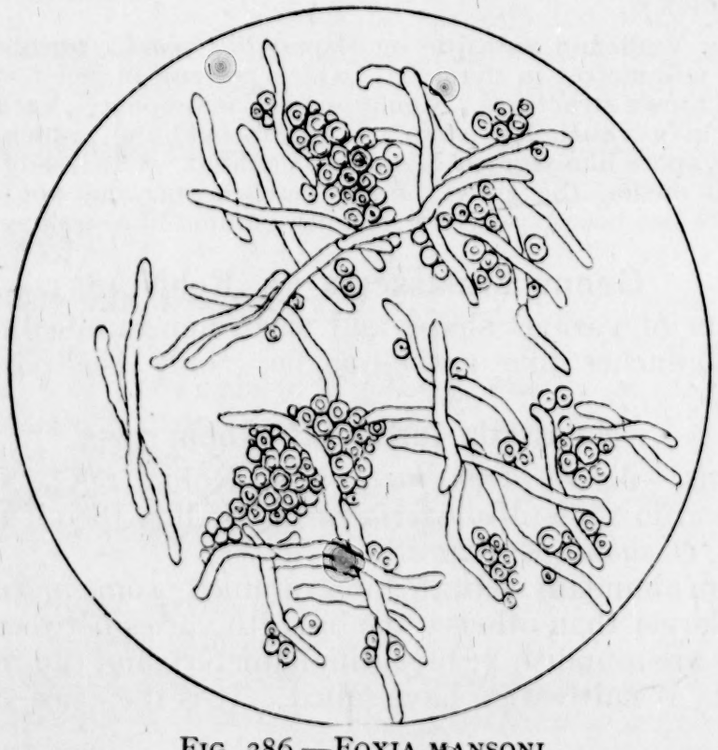

FIG. 286.—FOXIA MANSONI.
(From a fresh preparation in liquor potassæ. The mycelial tubes are in reality not so regular in outline as in this drawing.)

roundish (4 to 5 μ), with a double contour; are often collected in clusters. The fungus does not grow on artificial media. It is the cause of tinea flava or pityriasis flava of tropical climates.

FIG. 287.—FOXIA MANSONI.
(From a preparation stained with fuchsin.)

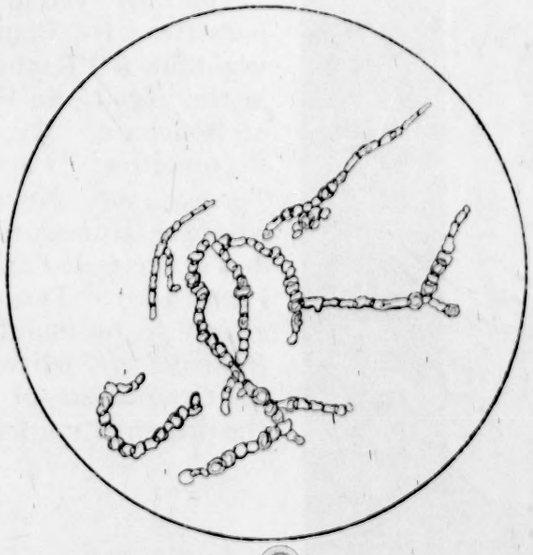

FIG. 288.—FOXIA MANSONI.
(Hanging-drop culture.)

Genus Foxia Castellani 1908.

One species.

Foxia mansoni Castellani 1905.

Synonym.—*Microsporon mansoni* Castellani 1905.

Mycelial articles straight or variously bent, 2·5 to 3 μ wide;

FIG. 289.—FOXIA MANSONI.
(Young agar culture.)

non-ramified spores large, globular, 5 to 10 μ in diameter, collected in clusters; spores are occasionally seen budding.

The fungus is easily grown on maltose and other sugar agars, and also on ordinary agar. On maltose and ordinary agar it gives rise to greenish-black granular colonies, which later fuse into a jet-black mass. It slowly liquefies gelatine after three or four weeks. In hanging-drop cultivations short mycelial threads are seen, terminating in long strings of roundish conidia. Lateral conidia are not seen, nor spindle-shaped organs, as found in *Trichophytons* and *Microsporons*.

This fungus is the cause of tinea nigra.

REFERENCES.

The best systematic work on vegetal parasites is Blanchard's 'Parasites végétaux à l'Exclusion des Bactéries,' in the 'Traité de Pathologie Générale' of Bouchard. Excellent textbooks are Perroncito's 'Parasitologia Umana,' Torino, 1906; Neveu-Lemaire's 'Parasitologie Humaine,' Paris, 1906; Verdun's 'Précis de Parasitologie Humaine,' Paris, 1907. The current literature is mostly to be found in the *Archives de Parasitologie*, edited by Blanchard; in the *Centralblatt für Bakteriologie* and in the principal journals of dermatology.

PART III

THE DISEASES OF THE TROPICS

diminished over the ulcer, and a most objectionable odour is exhaled, while a slight discharge of granular and necrotic débris is generally present. The ulceration may progress continuously for a period of ten to thirty-five years, or it may advance at certain times and be quiescent at others, or it may cease at any time, leaving a chronic ulcer.

With regard to the blood, Musgrave and Marshall report that their case showed no marked leucocytosis and no abnormal elements. The hæmoglobin was 80 per cent., the leucocytes 11,600 per cubic millimetre, the small lymphocytes 10 per cent., large lymphocytes 4·6 per cent., polymorphonuclears 82 per cent., eosinophiles 2·6 per cent., basophiles 0·4 per cent.

The disease is limited to the throat and nose, and as a rule the general health is but little affected.

A fulminating variety has been described by Mink and McLean in children which is fatal in forty-eight hours, and closely resembles diphtheria, without, however, the presence of the specific bacilli.

Diagnosis.—The diagnosis has been practically discussed in the Ætiology, and need not be repeated, except to say that it must be made by a process of exclusion.

Prognosis.—The disease is rarely fatal.

Treatment.—Nothing is at present known which is capable of arresting its progress. An application of a strong solution (1 per cent.) of permanganate of potash is recommended as a deodorant, and local application of tincture of iodine or the actual cautery.

Prophylaxis.—Nothing can be said under this heading, as the ætiology is quite unknown.

RHINOSPORIDIOSIS.

Definition.—Rhinosporidiosis is an infection of the nasal mucosa, with *Rhinosporidium kinealyi* Minchin and Fantham, which produces polypoid growths.

History.—In 1903 Kinealy reported to the Laryngological Society a peculiar case of a polypus growing from the septum of the nose of an Indian in Calcutta in the form of a pedunculated, raspberry-like body, with whitish spots on the general red surface. On section this tumour was found to have peculiar bodies embedded in it. It was then carefully examined and described by Minchin and Fantham, who came to the conclusion that the peculiar bodies were haplosporidians, and named them *R. kinealyi*. In 1905, Nair of Madras found similar nasal polypi in several people, who all came from the small native State of Cochin, on the west coast of India. These polypi were carefully described by Beattie in 1906.

Climatology.—At present it is only known in India.

Ætiology and Pathology.—The cause of the disease is *R. kinealyi* Minchin and Fantham, which by its growth causes the formation of a polypus, as has already been described in the chapter on Protozoa (p. 333).

Symptomatology.—The patient has his attention drawn to his nose by profuse bleedings, and in a little time notices a growth. On examination this is found to be a small vascular pedunculated tumour, about the size and shape of a pea, freely movable and painless, attached to the anterior and upper part of the cartilaginous septum. In appearance it resembles a strawberry or a raspberry.

Prognosis.—It does not appear to be dangerous to life.

Treatment.—The treatment is removal and cauterization.

HIRUDINIASIS.

Definition.—Hirudiniasis is the invasion of the nose, mouth, pharynx, or larynx by leeches.

Climatology. — Leeches have already been described in Chapter XVII., when it was mentioned that they were apt to invade the nose, mouth, pharynx, or larynx. Recently Masterman has given a very excellent account of hirudiniasis as seen in Palestine.

Leeches are most troublesome in Algeria, Palestine, and Ceylon, less so in the Philippine Islands, Java, Sumatra, Australia, and Japan.

Ætiology.—It is the water-leech, which lives in springs, which is the cause of trouble to man, as it is apt to be swallowed with drinking-water. This is particularly liable to take place when the traveller drinks the water hastily at dusk.

Pathology.—The leech, when in the mouth, nose, pharynx, or larynx, does not suck blood until gorged, and then detach itself from the affected part, as is the rule when it attacks the skin, but apparently bites and sucks a little in one place, and then passes to another, and bites and sucks again, and so on. Of course the sites of the bites bleed, and hence the patient may in course of time become very anæmic, and even die. It is hardly likely that a leech could live in the stomach if swallowed, though such an occurrence has been described.

Symptomatology.—The patient usually knows that he has swallowed a leech, and has felt the animal catch hold of the mucosa of the pharynx during the swallowing of the water. But children, and even adults, may be quite unaware of the accident having happened. The most important sign is the bleeding from the nose or mouth, or the hawking up of blood from the pharnyx, or hæmoptysis from the larynx, accompanied by a short irritating cough, dyspnœa, and sometimes cyanosis from the impediment to the respiration. Rhinoscopic or laryngoscopic examination may be necessary in order to see the parasite, and will require to be done with cocaine. In the larynx the head of the leech is usually fixed just inside or outside of the vocal cords, and the body may flop backwards and forwards with respiration.

Diagnosis.—The bleeding and the examination with a nasal speculum or a laryngoscope make the diagnosis easy.

CHAPTER XLIII

DISEASES OF THE ALIMENTARY CANAL (*continued*)—SPRUE AND HILL DIARRHŒA

Sprue—Hill diarrhœa.

SPRUE.

Synonyms.—Ceylon Sore Mouth, Aphthoides Chronica, Tropical Aphthæ, Impetigo Primarum Viarum, Diarrhœa Alba, Psilosis Linguæ et Mucosæ Intestini, Endemic Diarrhœa.

The term 'sprue' is a phrase used in Holland and Scotland for aphthous stomatitis in children, and was applied to this disease by Manson and Van der Burg, the latter calling the disease in Batavia 'Indische spruw.'

Definition.—Sprue is a chronic catarrhal inflammation of the alimentary canal, of unknown cause, characterized by a peculiar ulcerative condition of the tongue and mouth, and by the passage of large, pale, frothy motions, the symptoms waxing and waning periodically.

History.—Hillary, of Barbadoes, in 1766, in a most remarkably able manner, describes the disease for the first time under the name 'aphthoides chronica.' His account is well worth reading, and there can be no possible doubt that his description refers to the disease we now call sprue. The Indian physicians Twining (1835), Grant (1854), Cunningham (1877), mention symptoms indicating that they were acquainted with a disease of this nature.

At the same time—*i.e.*, 1864 to 1883—French physicians noted a peculiar form of diarrhœa, commonly met with in Cochin China, which perplexed them considerably, a large number believing that it was dysenteric in nature, while others considered that it was probably a new disease.

In 1880 Manson was the first after Hillary to clearly define the disease, which he called sprue; and in the same year, and independently, Van der Burg described it under the term 'Indische spruw' in Batavia. In the next year (1881) Sir Joseph Fayrer delivered the Lettsomian Lectures on chronic white tropical diarrhœa. These three authors permanently established the disease as a clinical

entity. Since then many important papers and articles have appeared, notably Roux's ' Traité ' in 1888, and Thin's ' Psilosis ' in 1897. The most modern account with a full history is Brown's monograph (1908).

Climatology.—The endemic home of sprue appears to be Asia, especially Malaya, Sumatra, Java, Siam, and Annam ; but it also extends into Burma, India and Ceylon, China, Australia (East and South), New Caledonia, the Fiji Islands, and Japan. Possibly it exists in the West Indies, where Hillary originally described it, and it may occur all through the tropics ; but if so, it must be rare in certain regions—as, for example, West Africa.

Ætiology.—The cause of sprue is quite unknown, though there are many theories. Thus Thin and Macfadyen found at times a special form of bacillus in the fæces, and noted the comparative absence of *Bacillus coli communis ;* but no organism has as yet been shown to have a definite causative action. *Strongyloides stercoralis* has been noted in the motions, but is not the cause of the disease. Dysentery is not causative ; at the most it can only be a predisposing cause of certain cases.

According to some observers, the disease is caused by bacilli of the *coli* group which only come into action after attacks of dysentery. According to others, the malady is due to some species of saccharomyces. Bassett Smith believes the disease to be a cirrhosis of the mucosæ, due to the action of bacteria. Van der Scheer's theory that the disease is a sequel of appendicitis is in our opinion untenable.

Pathology.—With an unknown causation, it is not easy to write an account of the pathology. It would appear as though the primary lesions are beneath the epithelium in both the tongue and the intestine, and cause the superficial desquamation and catarrh. In the intestine the disease begins with submucous congestion, after which follows thrombosis of the vessels, and exudation of hæmoglobin, and a round-celled infiltration. The mucosa suffers because its blood-supply is damaged, and therefore necrosis takes place, the glands and villi being affected. The œsophagus and stomach also suffer. The liver is at first enlarged and congested, but later becomes atrophied and small. The fact that the tongue, œsophagus, stomach, and intestines are affected would indicate that something deleterious is being carried by the blood-stream to these organs, rather than that something is acting from the surface. The irritation of the liver may be due to the same cause.

When once the mucosæ are damaged, the chemical processes of digestion and the absorption of their products must be interfered with, while at the same time the absorption of poisons from the alimentary canal must be easier. Indeed, there is evidence of this in the increase of indigo blue in the urine, which is at times marked.

These two conditions would lead to an atrophy of the liver, which organ is one of the great safeguards against a toxæmia of intestinal origin. When the liver is sufficiently damaged, a toxæmia is pos-

sible, and occurs ; hence, possibly, the advantage of the treatment by liver-soup or other preparations of liver.

The damaged condition of the mucosa of the mouth and tongue makes mastication difficult. The denuded condition of the œsophagus causes the burning pain during swallowing ; the condition of gastric and intestinal mucosæ causes the dyspepsia and diarrhœa of the disease. The diarrhœa is characterized by pale, frothy motions, the explanation of which is as follows :

On opening the bowels post mortem, the observer is struck by the fact that, though there may be plenty of bile in the duodenum and in the higher portions of the bowel, this gradually disappears until, in the lower parts of the small intestine, the contents appear white. In normal fæces bilirubin should be changed into stercobilin (hydrobilirubin), which is urobilin, and is identical with that found in the urine.

Vaughan Harley has shown that in the upper third of the small intestine the normal fæces are of a yellowish colour, due to bilirubin. In the middle third they are of a whitish or greyish colour, probably owing to the bile-pigments being converted into chromogens, which become green in the lower third. After passing the ileo-cæcal valve, the bile-pigments are converted into urobilin by the action of putrefactive bacteria, but a considerable quantity of this is in the form of a chromogen. If the pancreatic juice is absent, a colourless form of urobilin is found, called leuco-urobilin, which, on oxidation by air, may be reconverted into urobilin. It would appear, therefore, that the intestinal flora has altered its character in sprue, probably owing to some abnormality in the pancreas or the bowel.

Morbid Anatomy.—The body is emaciated, and the skin often hangs loosely, and there may be œdema about the ankles. The tongue shows small areas of infiltration into the connective tissue, vesicles, and small ulcers. The filiform papillæ atrophy, and the fungiform papillæ become swollen and prominent. The pillars of the fauces and the tonsils may show subepithelial inflammation, and even suppuration and ulceration. The œsophagus is inflamed, and its mucosa is attenuated in places. The mucosa of the stomach may be pale and atrophied, or rough and cirrhotic. The mucosa of the small intestine may be slightly eroded, or may be so destroyed that the whole bowel is diaphanous with vascular arborizations ; or there may be effusion into the solitary and agminated glands. The contents are bile-stained in the upper parts, and whitish lower down. The large bowel may be ulcerated. The liver is atrophied, but otherwise normal. The pancreas may be normal, inflamed, or cirrhotic. The peritoneum may be thickened and chronically inflamed, and in some cases show adhesions. The other organs are normal as a rule, but sometimes they are atrophied.

Symptomatology.—The incubation period of sprue is quite unknown, and the onset is insidious, without marked symptoms, which are usually merely failing strength and an undefined sense

of illness. The disease may begin with diarrhœa and intestinal symptoms, or with mouth symptoms only.

Usually it begins with slight attacks of sore mouth, indigestion, and morning diarrhœa, often of a bilious nature ; but as none of these are severe, and all are evanescent, the patient thinks little or nothing about them, and does not consult a medical man until the disease is well established. Three symptoms now worry the patient—viz., sore mouth, indigestion, and morning diarrhœa.

On examining the mouth, the dorsum of the tongue will be seen to have a whitish fur, through which the swollen fungiform papillæ are projecting. The sides and tip of the tongue are red and inflamed, with often small vesicles, small ulcers, and bare patches, which are very tender. Similar patches may be noted under the tongue near the frenum, on the inside of the cheeks, on the palate, and on the pillars of the fauces. A little ulcer, called Crombie's molar ulcer, may be seen near the two last upper or lower molar teeth. So tender is the mouth at times that deglutition, mastication, warm or spiced foods, acid or alcoholic liquors, cause much pain. In addition, mucus may be noticed clinging to the pillars of the fauces and to the back of the pharynx. This mucus is a source of great distress to the patient, as it accumulates in considerable quantities, especially if some warm fluid has been taken, and the effort to get rid of it makes him almost sick. On swallowing food, a burning pain is felt along the course of the œsophagus and over the sternum, as though there was something raw inside (as, indeed, there is). The voice is said by Thin to be altered at times, but we have not specially noted this.

The neck, thorax, and arms may show signs of emaciation. The abdomen is swollen, sometimes markedly so, especially in the epigastric region, and the wall is soft and relaxed. The patient complains of dyspeptic symptoms—viz., a sensation of discomfort and distension after meals, with acid eructations, and sometimes vomiting. Early in the morning he feels symptoms of intestinal discomfort, and passes a few copious, greyish, offensive, frothy motions, and no more for the rest of the day. After these motions he may feel much better, and have a good appetite.

Examination of the fæces shows mucus, epithelial débris, and many bacteria, and in some cases eggs of various worms may be present. The quantity of fæces passed varies with each motion, but is in excess of the normal, this being due to solids rather than liquids. The excretion of nitrogen and fat is increased.

The most complete analysis of urine and fæces has been carried out by V. Harley and Goodbody. The patient, weighing 36·87 kilogrammes, was on a milk diet, containing 12·99 grammes of nitrogen, 76·44 grammes of fat, 82·32 grammes of carbohydrates, and 1,960 c.c. of fluid. The urine passed measured 1,050 c.c. ; specific gravity 1,012 ; urea, 16·8 grammes ; uric acid, 0·8 gramme ; ammonia, 0·44 gramme ; phosphates, 1·27 grammes ; chlorides, 3·89 grammes. Total sulphates, 1·47 grammes, of which 1·35 grammes were alkaline and 0·12 aromatic. The average daily quantity of the motions was 255 grammes, of which 79·46 were water, 1·47 nitrogen, 35·92 fat. The

nitrogen given in the food was 12·99 grammes, and that in the fæces 1·47 grammes ; therefore 88·68 per cent. had been absorbed. The fat in the food was 76·44 grammes, and that in the fæces 35·92 grammes ; therefore 53·01 per cent. had been absorbed. The colour of the fæces was greyish-green to greyish-white, but gave a distinct urobilin reaction, due to the leuco-urobilin. Schmidt's test for urobilin is performed by adding a concentrated solution of perchloride of mercury to the fæces, when a bright red colour is developed if urobilin is present. If there is much urobilin, the colour appears within five minutes ; if little, in five to fifteen minutes ; if very little, in half an hour. The colour deepens for twenty-four hours. More analyses on the above lines are required. With regard to the stomach, at times there is said to be complete achlorhydria (Manson).

The blood coagulates slowly, and there is always some reduction of the red cells, which may fall as low as 3,000,000 to 1,000,000 per cubic millimetre. The colour-index is low, and the structure of the cells is normal. The white cells are also reduced to about 6,000 to 2,800 per cubic millimetre. The ratio of white to red is about 1 to 400 in bad cases. A differential count shows an increase in the mononuclears and eosinophiles.

The urine requires more investigation, but as far as evidence goes at present it is not abnormal, showing only an increase in indigo blue and urobilin, and at times Cammidge's reaction for pancreatitis.

The buccal, intestinal, and other symptoms may markedly improve, even without treatment, but only to get worse again ; and this is repeated time after time.

In due course the patient becomes very emaciated, weak physically, and depressed and irritable mentally. The skin becomes harsh ; the mucosæ anæmic ; the tongue becomes smooth, glazed, reddish-yellow, and small, and is often furrowed by cracks ; indigestion is marked ; and the diarrhœa is worse. The patient continues to lose weight, and emaciates rapidly, the skin hanging in loose folds, the abdomen blown out with gas, the liver small and atrophied, the ankles œdematous, while the pulse becomes slow and feeble.

After this has gone on for a long time, the emaciated, worn-out, irritable person dies of an acute attack of diarrhœa or cardiac failure. Sprue is essentially a chronic disease, with remissions, intermissions, and recurrences, but, unless taken seriously in hand, goes steadily from bad to worse.

Some writers distinguish three stages—a first stage, with oral and dyspeptic symptoms ; a second stage, with marked intestinal symptoms ; and a third stage, with toxæmia, emaciation, and anæmia ; while cases are sometimes seen which are atypical—that is to say, where there are the mouth symptoms without the intestinal symptoms, and *vice versa*.

Complications.—The complications met with in the course of the disease are : Acute diarrhœa ; dysenteric diarrhœa ; hæmorrhage ; meteorism ; pancreatitis ; myalgia ; insomnia ; helminthiasis, especially agchylostomiasis ; impacted fæces ; chronic appendicitis ; jaundice ; diabetes ; and pernicious anæmia.

Diagnosis.—The diagnosis of the disease is to be based upon the irregular chronic diarrhœa occurring especially in the morning, and associated with flatulent dyspepsia, causing distension of the abdomen, and the passage of fermenting, abundant, clay-coloured motions. With these symptoms there will be progressive emaciation and anæmia, and when to these the characteristic mouth-lesions occurring in a person living in the tropics are added, it is indeed difficult to imagine any disease with which it could possibly be confounded. Van der Scheer considers that the discovery of fat in the motions is a diagnostic sign before the disease begins; but this condition may also be found in pancreatitis. Low says that the so-called psilosis pigmentosa of Barbadoes is pellagra. The diseases from which sprue should be distinguished are stomatitis, hill diarrhœa, chronic dysentery, and chronic pancreatitis.

Stomatitis.—All forms of stomatitis are very common in the tropics, and may be accompanied by intestinal symptoms such as diarrhœa. The stools, however, do not show the peculiar characteristics of sprue—viz., the white colour, the frothy appearance, and the copious amount passed in the twenty-four hours.

Thrush.—This is easily diagnosed by examination of the white patches, in which *Endomyces albicans* will be found. It is, however, to be noted that in long-standing cases of sprue, as in all chronic complaints, thrush may develop.

Hill Diarrhœa.—The patient generally gives a history of residence at a high elevation, and the diarrhœa is as a rule present only in the morning, while mouth symptoms are absent. We have, however, seen several patients in whom sprue has developed after repeated attacks of what to all appearance was simply hill diarrhœa.

Chronic Dysentery.—In chronic dysentery there is an absence of the mouth symptoms, while the motions are not whitish in colour, and may contain blood and mucus during the exacerbations. The diarrhœa of dysentery is generally accompanied by griping, while that of sprue is not. In chronic dysentery pain is often felt on pressure over the sigmoid and descending colons. In some cases microscopical and bacteriological examination of the stools for entamœbæ and the Shiga-Kruse bacillus may be necessary to clear the diagnosis.

Though personally we consider sprue and chronic dysentery to be different diseases, still we have seen several cases of sprue developing in old-standing cases of chronic dysentery.

Chronic Pancreatitis.—Absence of the mouth symptoms of sprue and presence of tenderness in the region of the epigastrium and the passage of large quantities of fat in the motions, together with Cammidge's crystals in the urine, will enable the diagnosis of chronic pancreatitis to be made.

Prognosis.—The prognosis in any case of sprue is serious, because, unless the patient will honestly co-operate with the doctor, he will go from bad to worse. We are of the opinion that, no matter how mild the case may be, the patient should be warned of the danger.

If treatment is properly carried out, the prognosis improves considerably, but even then relapses are apt to occur.

Treatment.—The causation of the disease being unknown, the treatment must be symptomatic.

An attempt must be made to soothe the alimentary canal, and to give it as little work to do as possible, so that it may repair itself. This line of treatment will necessitate rest in bed and a careful diet, after the bowels have been swept as clear as possible of decomposing material.

While this is proceeding, care must be taken to avoid chills, as they aggravate the disease. Lastly, an attempt should be made to treat those symptoms which worry and annoy the patient.

The treatment, therefore, may be classified into—

1. The Co-operation of the Patient.
2. Rest in Bed.
3. Suitable Clothing.
4. Removal of Fermenting Bowel Contents.
5. Diet.
6. Medical Treatment.
7. Change of Climate.

1. The Co-operation of the Patient.—The nature of the complaint and the dangers which the patient runs must be carefully explained to him, and the line of treatment sketched out. Further, he must be told that its success or failure largely lies in his own hands. If he has not the strength of will to persevere, even when at first success seems far from certain, he might as well not begin. If he agrees to co-operate, then he must be carefully weighed, and a chart kept of his weights.

2. Rest in Bed.—The second point is that the patient must remain in bed for a little time, and use the bed-pan and the urine-bottle, in order to give the bowels as much rest as possible, and warm water must be used in sponging.

3. Suitable Clothing.—The underclothes and pyjamas should be of wool or flannel, in order to avoid chills.

4. Removal of Fermenting Bowel Contents.—The treatment should begin with a dose of castor oil, to remove the fermenting contents of the bowels.

5. Diet.—The various diets advised may be arranged as follows:

(*a*) The Milk Diet.
(*b*) The Milk and Fruit Diet.
(*c*) The Fruit Diet.
(*d*) The Meat Diet.
(*e*) The Meat and Milk Diet.

(*a*) *Milk Diet.*—The real basis of the treatment of sprue at present is the milk diet.

In the tropics this milk should be obtained from a cow kept for the purpose, or from some really reliable dairy, as the danger of contamination is great. Even when the cow belongs to the patient, great care has to be taken that the milk is not adulterated by the household servants. We can

never forget that once the milk of a peculiarly careful household, collected, apparently, under strict precautions, was found on analysis to be grossly adulterated. The lesson we have drawn from the above is to get a sample analyzed from time to time. This analysis costs but little, and the possibility of its being carried out at any time puts a certain amount of restraint upon would-be adulterators.

There is a considerable difference between the average composition of the milk supplied by *Bos taurus*, the straight-backed cow, and *B. indicus*, the hump-backed cow, which, in general terms, may be summarized by saying that the milk of the latter is much richer than that of the former. We have investigated this point, and are of the opinion that if 3 per cent. of fat is considered to be an average for *B. taurus*, then 5 per cent. should be reckoned for *B. indicus*.

In placing a patient upon a milk diet, the composition of the milk should be carefully considered, especially as regards the fat, for, as Harley and Goodbody have shown, no less than 47 per cent. of the milk-fat is passed out in the fæces.

Milk with high percentages of fat should, therefore, be diluted with whey, when the amount of nitrogen will be kept up, while the percentage of fat is diminished. Whey is easily made in the tropics by means of the juice of limes.

Preferably the milk should not be boiled or sterilized, but boiling, apparently, does not interfere with its beneficial properties, and therefore, if desired, or thought necessary—*i.e.*, owing to the risk of typhoid—there is no harm in so doing. In cold weather it should be warmed before being taken. It can be aerated in a seltzogene if desired, and can be mixed with Vichy water. Finally, it must be remembered that milk is not a perfect food for an adult, however suitable it may be for a child.

It is as well to begin with a small quantity, and to gradually increase the amount. Every medical man sooner or later adopts his own method of carrying this out, and we will, therefore, only give general directions. If the case is very severe, with vomiting and much diarrhœa, it is as well to begin with whey only, which the patient should sip slowly, and practically *ad libitum*—*i.e.*, about 7 to 8 pints per diem. As soon as the urgent symptoms are relieved, milk must be added to the diet, as whey alone is starvation.

If the case is of moderate severity, milk can be begun at once, 3 pints per diem being given in the more severe, and 4 pints in the less severe, cases—*i.e.*, 60 to 80 ounces—which should be divided into not less than ten meals at regular intervals during the day. The milk must be slowly sipped or taken through a glass tube, which, of course, should be carefully boiled after each meal. On no account must the patient be allowed to drink the milk in gulps. It is, perhaps, as well to define a limit of time—say about twenty minutes—as the minimum time for a meal.

If the symptoms improve, it is necessary to increase the milk gradually every few days until 6 to 7 pints—*i.e.*, 120 to 140 ounces—are given ; but in doing this, it is better to increase the number of meals rather than the quantity at a given meal. Twelve meals in the twenty-four hours are not difficult to arrange.

If the symptoms do not improve, the milk must be reduced gradually, or whey must be tried ; but as soon as the urgent symptoms of diarrhœa and vomiting abate, the milk must be gradually increased, and, indeed, the starvation must not be long continued in any case. Starvation diets are dangerous in severe cases when the patients are emaciated and weak ; and hence, while they are being employed, great care is required in nursing.

If the milk is succeeding, the diarrhœa ceases, the mouth troubles diminish, and the patient feels better. The fæces will at first be pale and grey, but, as improvement continues, stercobilin will appear, as evinced by the brown colour. This change in the colour of the fæces is a most important and excellent sign.

But even if milk is agreeing with the patient, there will be much trouble, as there is often strong objection to milk only. Another difficulty is constipation, and this must be relieved by enemata. Sometimes the milk does not agree, causing vomiting and pain. Usually this can be relieved by alkalinizing the milk with bicarbonate, 1 grain to the ounce, or the citrate of soda, 2 grains to the ounce of milk (convenient tabloids are prepared by Burroughs Wellcome and Co., of this salt), or by adding Apollinaris or Ems water in the proportion of equal parts, or lime-water, 1 to 6 of milk. As soon as a definite improvement appears, and the weight begins to increase, the patient should be allowed to sit up, but great care must be taken to avoid chills. Milk diet should be persisted in for a month or six weeks, but may be modified by the addition of fruit—*e.g.*, strawberries, bananas, or apples—as will be described later.

Then eggs may be beaten up in the milk ; chicken-broth can be tried ; then Benger's food, or some other simple food—Allen and Hanbury's, Mellin's, Albany food, Carnrick's soluble food, Sanatogen, or Plasmon. Then fish, chicken, or sweetbreads, with a biscuit, and, later, potatoes ; and finally, the patient is put on to a diet of eggs, toast, dilute China tea, soups, white meats, custard-puddings, milk. But he must avoid dark meats, most vegetables, spiced foods, iced drinks, and all indigestible substances. Alcoholic drinks in every form are bad, both during the illness and afterwards. Nor is smoking to be encouraged ; we, personally, are much against it.

But, unfortunately, a case of sprue is not so easy to treat as indicated above, for, while the food is being gradually and carefully increased, relapses are not infrequent, and a return to milk may be necessitated. The patient gets weary, and at times exceedingly angry about this dieting, and, indeed, is apt surreptitiously to kick over the traces, with disastrous results. The prohibition of alcohol also leads to trouble, but our experience about this is quite clear : if alcohol is taken, the progress of the patient is seriously hindered.

Before leaving the milk diet, two points ought to be mentioned, concerning one of which we have had considerable experience ; concerning the other, none at all. First of all, there can be no

reasonable doubt as to the advantages of liver-soup—*i.e.*, soup prepared from calves' or sheep's livers—in the milder cases of sprue, or in the return to ordinary food of a severe case. The liver treatment is really an old native remedy in Ceylon. We do not profess to advance views as to its action, but in a certain class of cases it is of benefit. Secondly, gall-pills and pancreatic preparations have been advocated by some; but of these we have no experience.

(*b*) *Milk and Fruit Diet.*—A milk and fruit diet has been found to be even better than a pure milk diet in many cases. The milk is administered as already described, but, in addition, fruit is given. Strawberries are most highly recommended, beginning with ¾ pound and gradually increasing to 2½ pounds per diem. They should be crushed, and eaten with sugar and cream. In lieu of strawberries bananas (not plantains, though people often call bananas plantains, the difference being that a banana shows three cells on transverse section and a plantain five), pears, grapes, in the same weight as the strawberries or apples, from ½ pound to 1½ pounds per diem. If these cannot be obtained, the juice of oranges, papaya (1½ pounds per diem), avocado pears, mangosteens, and sapodilla, may be used.

Fresh Bael fruit is excellent, but must be carefully prepared. It may be boiled in water and then cut open and shredded by means of a fork into warm milk, in which it is pounded with castor-sugar, and finally strained through a fine strainer to remove all débris. This should be used three times a day. Preserved fruit is said to be useful, if fresh fruit cannot be obtained. Acid fruits, such as pineapples and sour-sops, should be avoided, and, personally, we do not advise the use of mangoes.

(*c*) *Fruit Diet.*—This was first advocated by Van der Burg, and usually consists of grapes and pears; but it appears as though almost any fruit which is not acid might be used.

(*d*) *Meat Diet.*—If the milk or fruit diets fail, it is advisable to try a meat diet, or this may be made the basis of treatment from the beginning. Cantlie is the great supporter of this dietary.

If the patient is very ill, it may be necessary to begin with raw-meat juice, prepared by pounding sufficient good raw flesh in a mortar, so that, with the addition of 2 ounces of water and 20 minims of dilute hydrochloric acid, 6 ounces of meat-juice is obtained on straining. The quantity of meat required to obtain these 6 ounces will sometimes be quite considerable, and, as it varies in different regions, must be obtained by preliminary experiment. A little salt should be added to this juice, and 1 teaspoonful should be given every quarter of an hour in very bad cases, and rapidly increased in amount if successful.

As soon as the very serious symptoms subside, the meat diet should be started. Brown gives the following directions for preparing a meat diet: Take 2 pounds of good raw meat, free from fibrous matter, fat, and gristle, and 2 ounces of fresh suet, and mince and pound them up thoroughly. Sprinkle the pounded mass with a little salt, and divide into six portions. One portion, cooked in a small, well-buttered saucepan until the red colour has just disappeared, is given six times a day, as convenient. This portion, when cooked, is estimated as weighing 4 ounces. In addition, ½ pint of plain warm water, rice or toast water, is sipped half an hour before a meat meal, and a little tea, with lemon-juice instead of milk, taken twice daily. It may, perhaps, be as well to remind the reader that rice-water is an infusion of roasted rice.

In about a week this meat diet should be changed to a modified meat diet, which is first produced by the addition of fruit, followed in a little time by chicken, then and gradually by eggs, biscuits, and fish, until the dietary already mentioned under Milk is reached.

With a modified meat diet some people combine curdled milk. This is based upon Metchnikoff's researches, which showed that if the *Bacillus acidi lactici* is taken with milk, it generates large quantities of lactic acid in the intestines, particularly in the large bowel, and that this acid interferes with intestinal toxins. Various preparations of the germ have been placed on the market, including 'Sauerin,' made by Messrs. Allen and Hanbury, and said to be a pure culture of the germ. Brown gives the following directions for its use: 2 pints of milk are heated to 160° F., to kill off any bacteria which might happen to be present, and then are allowed to cool in a jug which has been boiled. When 100° F. is reached, 6 tablets of Sauerin are added, and 2 tablespoonfuls of sugar, when the milk is curdled in about three hours. This curdled milk is taken four times a day, between the meals of a modified meat diet, and is said to be efficacious.

It may be mentioned that curdled buffalo-milk is commonly used by the natives of Ceylon as a part of their food, and curdled milk is also used in India, and, indeed, in many other places by natives.

Under the heading of Meat Diets must be placed Cantlie's treatment, which consists of putting the patient to bed, applying a hot wet pack from the nipples to the groin for two hours, morning and evening, and giving three meals of 5 ounces of meat per diem, and, in addition, either beef-tea, beef-jelly, calves'-foot jelly, or a plain jelly every two hours. Castor oil is administered in 1½-drachm doses every morning for the first three days, and santonin in 3-grain doses morning and evening for three days. Strawberries, to the quantity of 3 to 4 pounds per diem, are also allowed between meals. When the stools become solid, and show brown colouring matter, a poached egg and pounded chicken are added, and, later, minced chicken, and, still later, the undercut of meat, with stewed celery, seakale, vegetable-marrow, pulled bread, and thin slices of bread, baked in an oven for twenty minutes.

(*e*) *Meat and Milk Diet.*—Cantlie now advocates that when a patient is on a meat diet, this should be stopped every third or fourth day for twenty-four hours, and that milk only be given during this period.

6. MEDICAL TREATMENT.—It may be said at once that astringents as a rule are dangerous, and that antiseptics are not useful. Santonin, which must be yellow, has been strongly recommended by Begg, who gives 5 grains night and morning in salad oil; but we have seen no benefit by this treatment. Recently Cantlie has had good results by the administration of 20 grains of ipecacuanha daily for two or three days in advanced cases.

The mouth may be treated with any appropriate mouth-wash—*e.g.*, glyco-thymoline, glycerine and borax, diluted liquor aluminis, etc. The teeth require attention, and if there is any pyorrhœa, this should at once be treated by syringing or spraying between the teeth with peroxide of hydrogen solution. Pain may be relieved by painting the raw surfaces with 2 to 5 per cent. solution of cocaine, novocain, alypin, or stovain. The pain along the œsophagus requires morphia. Janowski recommends 5 to 10 drops of a solution of 1 in 1,000 adrenalin, which, he says, gives prompt and permanent relief for œsophagitis. The muscular pains may be relieved by massage, or by pilocarpine nitrate, given in $\frac{1}{10}$ to $\frac{1}{5}$ grain doses three times a day. Intestinal pain may be relieved by hot packs, as recommended by Cantlie. Acute diarrhœa must be checked by

a dose of liquor opii sedativus or lead and opium pills. Dysenteric symptoms must be treated as described under Dysentery.

CHANGE OF CLIMATE.—It is obvious that, if possible, the patient should be transferred from the tropics to the temperate zone, but only if he is strong enough to travel. But there is no advantage in putting him on board a ship in such a condition that he will probably die when changing from the warm to cooler weather. Personally, we are not in favour of a person being sent from the low country to the hills. If he is able to travel, let him go to the temperate zone.

Prophylaxis.—Nothing of any practical value can be said under this heading.

HILL DIARRHŒA.

Definition.—Hill diarrhœa is a gastro-intestinal catarrh of unknown cause, occurring mostly at high altitudes in tropical regions, and characterized by the passage of several liquid, frothy, light-coloured motions in the early morning.

History.—Hill diarrhœa was first described by Grant in 1854, in the same paper as that in which he dealt with sprue and dysentery, and later as a disease quite distinct from sprue by Crombie in 1892. The latter writer held that it was liable to occur at an elevation of 6,000 or more feet in India, Europe, and elsewhere. In India he believed the monsoon to be a potent factor, associated, probably, with a diminished barometric pressure. We have seen cases in Ceylon occurring at much less elevation—for example, at about 3,000 to 4,000 feet.

More recently Duncan has put forward the view that mica in the water is the causative agent. This mica is found in the laterite —*i.e.*, weathered gneiss—which is a common geological formation in the tropics. Singer considers that he has met this disease in four out of six Europeans on an expedition to Abyssinia, when they reached a height of about 5,000 feet.

Ætiology.—The causation of the disease is quite unknown. The theories are: diminished atmospheric pressure, the irritation of mica, fæcal contamination of the water, and exposure to cold.

Pathology.—Very little can be said under this heading, except to invite attention to what has already been written under the heading of Sprue with regard to the formation of leuco-urobilin, and to point out that it is obviously to the formation of this body, and not to anything wrong with the liver, that the colour of the motion is due. The morbid anatomy would appear to be totally different from that of sprue, and to be a congestion of the mucosæ of the stomach and bowels, with a proliferation of the mucosal lymph and fibrous tissue in chronic cases. On the surface of the mucous membrane of the small and large bowels there is a thick layer of mucus, but no ulceration.

Symptomatology.—The disease generally begins soon after the patient has arrived in the hills from the plains.

The onset is sudden, beginning with abdominal pain in the early hours of the morning, with the passage of large, frothy, greyish or whitish motions, which produce a sense of relief. The patient goes about his work, but in the early hours of the next morning the symptoms are repeated, and he will complain that his stomach feels blown out, and that he can hear gurgles, and this goes on morning after morning.

If now the patient leaves the hills and comes down to the plains to consult a doctor, he is astonished to find that he is quite well, and perhaps goes back to the hills without having obtained the medical advice which he desired. A relapse takes place, for which he does not as a rule seek advice, as he considers it a trivial compaint, until later he begins to feel dyspeptic, disinclined for his food or work, and now he will seek treatment, notwithstanding the fact that he feels better on returning to the plains. The disease may become chronic, and rarely may lead to a fatal result.

Sequela.—It is said that neglected hill diarrhœa may develop into sprue.

Diagnosis.—The history of the case and the absence of mouth symptoms are sufficient to enable the diagnosis as a rule to be made from sprue.

Prognosis.—The prognosis is good, as recovery is generally quick under suitable treatment, but in certain cases it is found necessary to abandon residence at high elevations.

Treatment.—The treatment is simple and effective. It consists in rest in bed, warm clothing, and ½ to 1 drachm of liquor hydrargyri perchloridi, given fifteen minutes before each meal, and 12 to 15 grains of pepsin, ingluvin, or lactopeptin two hours after the meal. The diet is to be milk, which may be diluted as advised in the treatment of sprue.

Prophylaxis.—Persons liable to the disease should avoid the hills, especially in the monsoon season, and if compelled to go to high altitudes, should do so by easy stages.

Low-Country Morning Diarrhœa.—This affection, common in Ceylon, somewhat resembles hill diarrhœa, but is found in the plains.

The patient wakes up about 3 to 4 a.m. with an urgent call to evacuate the bowels, but there is no abdominal pain or straining. After an interval of one to two hours the bowels are again evacuated, and perhaps again two or three more times in the course of the morning.

The motions are liquid, generally yellowish or brownish, and do not contain blood or mucus.

The condition lasts, as a rule, for months, but usually ceases on a change of climate.

A dose of tannalbin (gr. xv.-xxx.) or bismuth subnitrate (gr. xv.-xxx.) may be given at bedtime as a palliative.

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ENDEMIC ENLARGEMENT OF THE OS CALCIS.

Definition.—Endemic enlargement of the os calcis is a disease of unknown causation, characterized by fever, pain, and tenderness over, and subsequently enlargement of, the os calcis.

History and Climatology.—This disease was first described by MacLean in 1904 in Fantis and Krooboys in the Gold Coast Colony, and subsequently in 1905 by Maxwell in natives of Formosa.

Ætiology.—The ætiology and pathology are obscure, but in some way it is connected with the wet season, as attacks and recurrences take place then.

Symptomatology.—The disease begins suddenly with fever, great tenderness over the os calcis, with local pain so severe as to prevent sleeping and walking. In three to seven days the outer surface of the bone begins to increase in size, and continues to do so for some two weeks, during which time the pain lessens and the temperature falls to normal.

In about a month the swelling reaches its maximum size, at which it may remain for about one to two months, during which time the pain is moderate and walking is possible. After this the bone diminishes to about half the maximum size, but sometimes considerable enlargement persists. Usually the disease is bilaterally symmetrical, but it may occur on one side only. It affects the outer surface as a rule, but may also attack the posterior third of the bone.

Rarely it attacks other tarsal bones, but has never been reported as affecting a joint. Yearly recurrences during the wet season are common.

Treatment.—Medical treatment is useless, but relief is given by cutting down on to the affected area and trephining a hole into the bone.

Prophylaxis.—Concerning this nothing is known.

'MYCETOMA.'

Synonyms.—Madura-Foot, the Fungus Disease of India, Godfrey and Eyre's Tubercular Disease, Endemic Degeneration of the Bones of the Foot, Morbus Tuberculosis Pedis, Morbus Pedis Entophyticus, Podelkoma, La Maladie de Ballingall, Slipada, Hatty-ka-Pung, Keerenagrah (signifying a dwelling of worms), Kirudeo (signifying a dwelling of worms), Ghootloo Mahdee (signifying eggs of insects; probably so called from the small bodies found in the discharge).

Definition.—'Mycetoma' is a generic term for the invasion of the tissues of the foot and hand, and more rarely other parts of the body by fungi belonging to the genera *Discomyces*, *Aspergillus*, *Madurella*, *Oospora*, and *Indiella*, which produce enlargement, deformity, and destruction of the affected area.

History.—It is probable that mycetoma was known to ancient Indian writers on medicine, for references are found to a disease of the foot characterized by swellings like plum-stones, associated with a considerable amount of discharge, and thought to be due to injuries caused by thorns.

In 1712 Kaempfer drew attention to a disease of the foot, which he called 'perical,' or large foot, in natives of India. It is not very clear what he meant by this, as he may have confounded elephantiasis with mycetoma. In the early nineteenth century the disease was well known in the South of India, where it was called 'Madura-foot,' being described by Heyne in 1806, and mentioned in Brett's 'Surgery,' in 1840 as a distinct disease. In 1842 Gill appears to have been the first to clearly differentiate it, and he was followed by Godfrey in 1844 and 1846, Morehead in 1846, Colebrook in 1848; but many of these early writers appear to have considered the disease to be tubercular.

Ballingall, in 1855, was the first to state that it was probably of parasitic origin, and he was followed by Rustomji, who gave careful clinical histories of eight cases.

In 1860 Eyre gave an account of the disease, and V. Carter published the first of a series of most important papers extending till 1874, in which he studied the whole subject most minutely, and found the causal agent to be a fungus. In 1859 he discovered the fungus of the melanoid or black variety, now called *Madurella mycetomi* Laveran 1902, and later, in the same year, he found the fungus of the ochroid, or white variety, which is at the present time called *Discomyces maduræ* Vincent 1894. He was followed by a large number of observers, among whom may be mentioned H. J. Carter, who in 1862 described a fungus belonging to the Mucoridæ, which Berkeley in 1865 called *Chionyphe carteri;* but their methods of separating and growing this fungus were crude, and there is no doubt that it was a contaminative fungus. Lewis and Cunningham in 1875 did not believe in the fungoid origin, and ascribed the disease to degenerations; and in 1876 Kemper and Jamieson described a curious case of foot disease under the term 'podelcoma' as occurring in America. It is probable that this may have been a case of mycetoma, but if so, it was remarkably acute in its course. Bassini in 1888 described an undoubted case in Italy, and Wright a similar case in an Italian in America. In 1892 Kanthack and Hewlett independently studied the pathology of the disease, and concluded that it was really an actinomycosis. In 1893 Boyce and Surveyor examined a number of cases and grew the fungus artificially. In 1894 Vincent published an account of a case of the white variety occurring in Algeria. He cultivated the parasite, and inoculated it without success into animals, and finally named the variety *Streptothrix maduræ*, thus clearly differentiating one variety of the disease.

In 1895 Adami and Kirkpatrick published an account of the first undoubted case in Canada, and later similar cases were reported in other parts of America; and in 1897 Unna studied the pathology of the disease. In 1901-02 Bouffard described black and white varieties of the disease as occurring in Somaliland.

In 1902 Laveran investigated Carter's black variety, and named it *Streptothrix mycetomi;* and Foulerton and Jones published a paper on the pathogenesis of the Streptothrix group. Nicolle and Brunswic-le-Bihau described a case of white mycetoma in Tunis, caused by *Aspergillus nidulans*, cultivated by Nicolle and Pinoy. The fungus was introduced into the foot by a grain of barley. In 1906 Brumpt published a most valuable paper, showing that actinomycosis was the cause of one variety of mycetoma, and that Carter's, Vincent's, Nicolle's, and Bouffard's white and black mycetomata were all separate varieties of the disease caused by distinct fungi, and in addition, he described two other varieties, making a total of eight varieties due to separate fungi. In 1907 Musgrave and Clegg described a new form of the disease in the Philippine Islands, due to *Streptothrix freeri*, which they successfully inoculated into the foot of a monkey. This fungus they now consider to be identical with *D. asteroides*.

Climatology.—The disease is diffused throughout the world, being known in Asia, Africa, Europe, and America, but is far more com-

monly met with in the tropics than in the temperate zone, and is especially prevalent in India, particularly in the Madras Presidency about Madura, Bellary, Tanjore, and Trichinopoli.

In Asia it is known in India, not merely in Madras, but also in Cochin, Pondicherry, Sind, Cutch, Bengal, Rajputana, the North-West Provinces, the Punjaub, and Kashmir. It also occurs in Ceylon and Aden. In Africa it is also widespread, being met with in Madagascar, Somaliland, Abyssinia, Jibuti, the Sudan, Egypt, Algeria, Morocco, and Senegambia. In Europe it is rarely met with, but cases have been reported from Cyprus, Italy, and France. In America it has been reported as occurring in Canada, the United States, Nicaragua, the West Indies, Argentina, and Chili.

With regard to the known distribution of the varieties, the actinomyotic has only been reported from Madagascar; Porter's black mycetoma from India, Italy, and Senegambia; Carter's ochroid variety from India, Somaliland, Abyssinia, Algeria, Cyprus, Cuba, and Argentina; Bouffard's black and white varieties from Somaliland; Brumpt's white variety from India; Reynier's white variety from Paris; and Musgrave and Clegg's from the Philippine Islands. It is not definitely known what influence the season of the year has on the occurrence of the fungus, though probably when the saprophytic history is known some such influence may be discovered.

Ætiology.—The disease is due to the entry of a fungus into the subcutaneous tissue of some part of the body by means of a wound.

The region invaded is usually the foot, more rarely the hand, and still more rarely some other region.

The causal fungi may be classified as follows:

Order.	Genus.	Species.
Ascomycetes	Aspergillus	A. nidulans Eidam 1883.
		A. bouffardi Brumpt 1906.
	Oospora	O. tozenri Nicolle and Pinoy 1908.
Hyphomycetes	Discomyces	D. bovis Harz 1877.
		D. maduræ Vincent 1894.
		D. asteroïdes Eppinger 1890.
	Madurella	M. mycetomi Laveran 1902.
	Indiella	I. mansoni Brumpt 1906.
		I. reynieri Brumpt 1906.
		I. somaliensis Brumpt 1906.

The saprophytic life of these parasites is quite unknown, with the sole exception of *Discomyces bovis*, which lives in the spikelets of various cereals.

The disease occurs most commonly in people who walk barefoot, and is therefore most usually met with in native races, though race *per se* has no predisposing influence. It is principally found in agricultural labourers, and is therefore more common in the poorer classes and in males.

Pathology.—The causal fungus is introduced into some part of the body by a wound produced by a thorn, a splinter of bamboo or other wood, by a sharp stone, knife, etc., but perhaps the most

interesting recorded case is Vincent's Tunis case, in which the disease was started by an injury to the foot by a grain of barley. Once introduced into the subcutaneous tissues, it commences to grow, the original wound in the meantime healing. Usually the growth is slow; but if Kemper and Jamieson's case was true mycetoma, it may be rapid, and, indeed, this is supported by Musgrave and Clegg's inoculation of *Discomyces asteroïdes* into monkey's feet, in which the swelling developed in ten to sixteen days, and was quickly followed by suppurative lesions. As the fungus grows it destroys the tissues of the foot, and meets with but little reaction on the part of the body, and no attempt is made to repair its ravages. The reaction on the part of the body confines itself to a lymphocytic infiltration around the fungus, and later the formation of granulation tissue, with epithelioid and giant cells at times; while, finally, fibrous tissue is formed around the fungus and its surrounding cells, and the vessels become blocked by an endarteritis and periarteritis. This appears to be an attempt to encapsule and prevent the spread of the parasite, as well as to damage it by cutting off its food-supply.

At the same time the cellular exudate becomes a thin, oily, often stinking, pus, and works its way to the surface, forming apertures, and carrying the parasite with it. This must be considered to be an attempt to rid the body of the fungus.

In the meanwhile the parasite forms special club-shaped hyphæ chlamydospores, which at first serve for extracting nutrition from the surrounding leucocytes, but later, breaking free from the main mass, form means of asexually propagating the fungus in the foot. Some of these separated clubs are attacked and engulfed by leucocytes, and though it is possible that in this way many may be destroyed, still, Brumpt's researches show that the leucocyte, with its enclosed club, may wander away from the diseased area into healthy tissue, and may be killed by the club, which, being set free, grows into a new mass of fungus. In this way the fungus may be disseminated by means of the phagocytes.

When surrounded by pus, the fungus gathers itself into granules, the so-called sclerotia, which show externally radially arranged fibres or clubs, and internally a mass of mycelium with crystals and débris, the latter being most marked in the centre. These granules escape to the exterior, and form the yellow, black, or pink granules in the discharge. As the fungus grows in the foot the connective tissues and the muscles undergo vitreous degeneration, and break up into débris, amongst which pieces of nerves and tendons may be found, while even the bone in some cases becomes attacked by a form of degeneration and disappears. The result is that the foot appears much swollen externally, and shows the openings of the sinuses, through which the pus and the fungoid granules escape; while internally the normal structure may have completely disappeared, being replaced by degenerated tissue, débris, sinuses, and fibrous sacs containing the fungus and the pus.

The result is, however, not merely destruction of the foot, but also great bodily waste, due to the continuous discharge, so that the patient becomes emaciated, and may finally die of asthenia. Very rarely do the fungi invade the body, as is the case with *Discomyces bovis*, which may give rise to a general infection.

The peculiarity of the pathology is the slight reaction which the body makes against the invasion by the fungus, and the entire absence of any attempt at repair.

The black varieties of mycetoma owe their colour to a dark substance which they secrete. The nature of this black substance is not known. It is soluble in hot sulphuric acid, forming a yellowish-red solution, but is not soluble in cold sulphuric acid nor in potash solutions.

According to Thudichum, it does not contain hæmoglobin in any form, though a small quantity of iron is present. The nature of the yellow pigment does not appear to have been investigated, though Musgrave and Clegg remark, with regard to *Discomyces asteroïdes*, that a pigment of the appearance of hæmoglobin may be seen.

Morbid Anatomy.—Externally the swollen foot shows nodules and openings, the latter of which lead into the sinuses. In sectionizing the foot it will be noticed that the sinuses run in various directions, and end in small cavities containing pus and the fungus, and that these cavities are embedded in degenerated tissue and débris.

The bone may or may not be affected, but if it is, the whole foot can be easily cut by a knife.

Microscopically the tissues simply show degeneration and débris, with fibrous tissue formation, endarteritis, and periarteritis, and at times absorption of the bone. Inside the fibrous capsules will be found pus cells and the fungoid mass, consisting externally of clubs or radiate hyphæ mixed with leucocytes, and internally of a mycelial mass.

Symptomatology.—The disease usually begins in the foot, more rarely in the hand, and still more rarely in the leg, knee, neck, or trunk. There may or may not be a history of a cut or injury some time previously. In any case this primary injury will have healed long before the disease is well established.

The incubation period in well-recorded cases would appear to be short; thus, in Musgrave and Clegg's case, one month after the primary injury the wound reopened and discharged pus, and in their experiments on monkeys it appeared to vary from ten to sixteen days. Further researches on this point are, however, required.

The earliest signs are either pain or swelling in the region of the original injury, which is usually on the sole of the foot, between the toes, or on the instep. The swelling becomes a hard lump, on the surface of which a bleb may form, which bursts and reveals a small opening discharging an oily, rarely sanious, thin, offensive pus, in which the granules characteristic of the fungus may be found.

Soon new indurations and nodosities appear in various parts of the foot, and new openings are formed, while the whole foot begins to swell in a very characteristic manner. First the arch of the foot fills up and disappears, the whole sole becoming so swollen and convex that the toes are no longer able to touch the ground, and may be pushed apart, but are usually not affected by the disease. At the same time the dorsum of the foot becomes studded with nodules and openings. The colour of the integument may be normal, but is usually darker than in the healthy foot. It is rarely

FIG. 348.—MYCETOMA.

œdematous. The openings, when examined by a probe, are found to lead into sinuses, which penetrate deeply into the tissues, and at times even into the bones of the foot. The quantity of the discharge varies from time to time, being increased by motion. On palpating the affected area, it is found to be elastic, and the sensibility to be normal.

As the disease progresses, pain, which at first was slight, becomes more marked, especially in cold weather. The patient ceases to be able to place the foot to the ground, and is compelled either to walk on the heel or to use a support. The leg begins to waste,

and after a long time the patient becomes weak and anæmic from the constant drain on the system, but general constitutional disturbance of a febrile nature is rare.

The disease is very chronic, and has no tendency to heal, and if not treated, will eventually cause the death of the victim, from exhaustion or diarrhœa, after lasting some ten or twelve years.

Varieties.—The disease can be classified by the different causal fungi into nine varieties, which may be arranged, according to the colour of the granules or sclerotia, into the black or melanoid group, and the white or ochroid group, as follows :

A. The Melanoid Group.

1. Carter's black mycetoma.
2. Bouffard's black mycetoma.
3. Nicolle and Pinoy's black mycetoma.

B. The Ochroid Group.

4. Carter's white mycetoma.
5. The actinomycotic white mycetoma.
6. Nicolle's white mycetoma.
7. Brumpt's white mycetoma.
8. Reynier's white mycetoma.
9. Bouffard's white mycetoma.
10. Musgrave and Clegg's white mycetoma.

A red variety has been described in Africa due to *Penicillium bouffardi* Brumpt 1906, but has not so far been completely investigated.

1. *Carter's Black Mycetoma.*—The sclerotia are hard, irregular, brittle, black or dark brown in colour, 1 to 2 millimetres in diameter. The hyphæ are white, but the interhyphal substance is dark brown. This is the type of the disease, and is caused by *Madurella mycetomi* (Laveran) 1902.

2. *Bouffard's Black Mycetoma.*—The sclerotia are moriform, elastic, and vary in size from a pin's head to a small pea. The grains are contained in giant cells. The disease, which is readily amenable to treatment by curetting, is caused by *Aspergillus bouffardi* Brumpt 1906.

3. *Nicolle and Pinoy's Black Mycetoma.*—The sclerotia are hard, small, and black. During parasitic life the mycelium is septate, 1 to 4 microns in breadth. Chlamydospores are present. It is found in Algeria and Tunis.

4. *Carter's White Mycetoma.*—The sclerotia are yellowish-white, mulberry-like, spherical grains, varying in size from minute pin-heads to peas. It is caused by *Discomyces maduræ* (Vincent) 1894.

5. *Actinomycotic White Mycetoma.*—The sclerotia are yellowish and soft. The disease destroys the bones, and can spread throughout the body, forming metastases in distant organs. The causal fungus is *Discomyces bovis* (Harz) 1877.

PLATE VI.

MYCETOMA.

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5. The actinomycotic white mycetoma.
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8. Reynier's white mycetoma.
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PLATE VI.

MYCETOMA.

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6. *Nicolle's White Mycetoma.*—The sclerotia are large, rounded, and smooth, like peas. It attacks the bones. The causal fungus is *Aspergillus nidulans* (Eidam) 1883.

7. *Brumpt's White Mycetoma.*—The sclerotia are very small, hard, and bean-shaped. The fungus in the foot lacks the connective-tissue sheath normally present. The causal fungus is *Indiella mansoni* Brumpt 1906.

8. *Reynier's White Mycetoma.*—The sclerotia are very large, soft, coiled masses. It is due to *Indiella reynieri* Brumpt 1906.

9. *Bouffard's White Mycetoma.*—The sclerotia are large, spherical or polyhedral grains, sometimes white, sometimes reddish-yellow in colour. It destroys bone. It is caused by *Indiella somaliensis* Brumpt 1906.

10. *Musgrave and Clegg's White Mycetoma.*—The sclerotia vary in size from 0·25 to 5 millimetres. Oval at first, they become various shaped when full-grown. The fungus which invades the medulla of the bone is *Discomyces asteroides* Eppinger 1890.

Diagnosis.—The peculiar swelling of the foot, with a filling-up of the arch, and the formation of sinuses from which a discharge containing the typical sclerotia is escaping, enables the disease to be diagnosed with certainty from elephantiasis or tubercular disease of the foot.

The variety of the fungus may be determined by examining the grains or the scrapings of the sinuses microscopically, culturally, and by inoculations in animals.

Prognosis.—The disease is incurable unless treated surgically.

Treatment.—The diseased area, if localized, may be removed by curetting or excision; but if a large area of the foot is affected amputation must be performed well above the boundary of the disease.

Prophylaxis.—Prophylaxis consists in guarding against wounds from pieces of wood, stones, etc., by wearing boots, shoes, or sandals. Should a wound occur, it must be thoroughly cleaned with antiseptic lotions before being allowed to heal.

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CHAPTER LIII

NERVOUS DISEASES

General remarks—Endemic paralytic vertigo—Lâtah—Schamanismus—Âmok—Tropical neurasthenia—Endemic peripheral neuritis—Erythromelalgia tropica—Desert hallucinations—References.

GENERAL REMARKS.

THE nerve diseases of the tropics include many general diseases already dealt with—*e.g.*, pellagra, malaria, leprosy, beri-beri, etc. But apart from these conditions, meningitis, cerebral tumours, cerebral hæmorrhages, spastic paralysis, alcoholic neuritis, and, more rarely, arsenical neuritis, are all well known. Locomotor ataxia and general paralysis—the so-called parasyphilitic affections—are rare, though syphilis is rampant. The cerebral tumours which we have most commonly met with are endotheliomata and tubercular or syphilitic lesions. Hysteria is common among the better-class natives, especially among the young women educated according to Western ideas.

As regards insanity, mania and melancholia are the most usual; but dementia, idiocy, and epileptic insanity are not uncommon. According to Dr. Spence, Superintendent of the Asylum at Colombo, the burden of lunacy in Ceylon is light as compared with England, Scotland, or Ireland, and it is possible that this applies not merely to Ceylon, but to other countries. But apart from these diseases, there are some curious nerve or mind affections which must be considered at greater length.

Tropical 'kohler' has already been mentioned (p. 65), but tropical neurasthenia must be dealt with.

ENDEMIC PARALYTIC VERTIGO.

Synonyms.—Vertige Paralysant, Vertige Ptosique, Gerlier's Disease, Kubisagari, Tourniquet.

Definition.—Endemic paralytic vertigo is characterized by eye symptoms, such as ptosis, dimness of vision, and by paralysis of the neck and extremities.

History.—The disease was first described by Gerlier in Ferney, in Switzerland, in 1886, and by Miura, in 1894, in Japan.

CHAPTER LV

SKIN DISEASES (*continued*)—TROPICAL DERMATOMYCOSES

Tropical dermatomycoses—Tinea cruris—Tinea albigena—Tinea alba—Tinea sabouraudi—Tinea nigro-circinata—Tinea imbricata—Tinea intersecta—Tinea flava—Tinea nigra—Blastomycosis—Sporotrichosis—Aspergillosis—Pennicilliosis—Pinta—References.

TROPICAL dermatomycoses—that is to say, tropical skin diseases caused by fungi higher than bacteria—may be classified as follows :

TROPICAL DERMATOMYCOSES.

I. Due to fungi of the genus *Epidermophyton* Sabouraud 1907	*Ep. cruris* Castellani, Tinea cruris, dhobie itch	
	Ep. perneti Castellani, variety of Tinea cruris.	
	Ep. rubrum Castellani, variety of Tinea cruris.	
II. Due to fungi of the genus *Trichophyton* Malmsten 1845	*T. albiscicans* Nieuwenhuis, Tinea albigena.	
	T. macfadieni Castellani, Tinea alba.	
	T. blanchardi Castellani, Tinea sabouraudi.	
	T. ceylonense Castellani, Tinea nigro-circinata.	
III. Due to fungi of the genus *Endodermophyton* Castellani 1909	*En. concentricum* Blanchard, Tinea imbricata.	
	En. castellanii Perry, Tinea intersecta.	
IV. Due to fungi of the genus *Malassezia* Baillon 1889	*M. tropica* Castellani, Tinea flava.	
V. Due to fungi of the genus *Foxia* Castellani 1908	*F. mansoni* Castellani, Tinea nigra.	
VI. Due to fungi of the genus *Microsporoïdes* Neveu-Lemaire 1906	*M. minutissimus* Burchardt, erythrasma.	
VII. Due to fungi of the genera *Saccharomyces* Meyer 1838 ; *Cryptococcus* Kützing 1872	*S. gilchristi* and other as yet not well-determined species.	Varieties of tropical blastomycosis.
VIII. Due to fungi of the genus *Sporotrichum* Link 1809	*S. indicum* Castellani, Variety of tropical sporotrichosis.	

IX. Due to fungi of the genera *Aspergillus* Micheli 1727 ; *Penicillium* Link 1809
- *A. barbæ* Castellani, Aspergillosis of hairy parts.
- *P. barbæ* Castellani, Penicilliosis of hairy parts.

X. Due to fungi of the genera .. *Aspergillus* Micheli 1725, *Penicillium* Link 1809, *Monilia* Persoon 1801, *Montoyella* Castellani 1907 — Pinta.

XI. Due to fungi of the genus *Trichosporum* Behrend 1890
- *T. giganteum* Behrend, piedra.
- Species as yet not well determined — Tropical varieties of nodular trichomycosis.

TINEA CRURIS.

Synonyms.—Dhobie Itch, Tinea Inguinalis, Eczema Marginatum.

Historical and Geographical.—Tinea cruris is extremely common all over the tropics ; it is met with also in subtropical regions, and in temperate zones, being first described by Hebra in Europe, where it is now well known owing to the researches of Sabouraud and Mibelli. In 1905 Castellani, as the result of the investigation of numerous cases, came to the conclusion that it should be separated from the ordinary forms of tinea corporis, the fungi causing dhobie itch being different species. Macleod suggested the name *Tinea cruris* for the affection. In 1907 Sabouraud created the genus *Epidermophyton*, the fungi found in *Tinea cruris*.

Ætiology.—According to Castellani's researches, at least three different species of epidermophytons may give rise to the eruption—*Ep. cruris, Ep. perneti, Ep. rubrum*—and there are probably several varieties of each species.

Epidermophyton cruris Castellani 1905 (synonyms, *Trichophyton cruris* Castellani 1905, *Epidermophyton inguinalis* Sabouraud 1907, *Trichophyton castellanii* Brooke 1908).—This is the commonest species ; in Ceylon the majority of the cases are due to it.

The fungus is very abundant in recent cases, but it is extremely scarce in cases of old standing. The mycelial tubes in fresh cases are generally straight, have often a double contour, and the segments are rectangular, their breadth being $3\frac{1}{2}\,\mu$ to $4\frac{1}{2}\,\mu$; branching is not rare ; the spores are rather large (4 to 7 μ), roundish, and present a double contour ; they never collect in clusters. In chronic cases degeneration forms of the fungus are met with ; the mycelium may be banana-shaped, presenting several constrictions, or long strings of ovoid elements may be seen.

The fungus is easily grown by using sugar media, of which the best is Sabouraud's maltose agar. In cases of old standing the fungus is grown only with great difficulty, owing to the scarcity of it in the lesions ; the material to be inoculated must be taken from the edges of the lesion. The growth begins to be visible after five to nine days ; the rate of growing is very slow. After three to four weeks the colonies are often about $\frac{1}{2}$ inch, and even much more, in diameter. The colonies are often orbicular-shaped, hard, and with a

pulverulent surface. The colour at first is greyish-yellowish, with occasionally a greenish tinge ; later it becomes greyish white.

Inoculation experiments on man with pure cultures, with the object of reproducing the disease, were tried by Sabouraud and Castellani, but without success.

Epidermophyton perneti Castellani 1907.—This *Epidermophyton*, which has been investigated by Pernet, is microscopically very similar to *Ep. cruris ;* the cultural characters, however, are different, the fungus growing much more rapidly, and presenting a pinkish colour, which is always lost in subcultures. This fungus is found in very rare cases only. Clinically the lesions caused by it are indistinguishable from those caused by *Ep. cruris.*

Epidermophyton rubrum Castellani 1909.—In fresh preparations the fungus resembles *Ep. cruris* and *Ep. perneti,* but the mycelial segments are often shorter.

In glucose-agar and Sabouraud's agar the growth shows a beautiful deep blood-red colour, which is not lost in subcultures. In ordinary agar cultures the pigment is always absent, the growth being of a whitish-grey or slightly greenish colour.

Symptomatology.—The term ' dhobie itch ' is used very loosely in the tropics by the lay public to denote practically any pruriginous skin affection. The term is, however, specially used to denote a form of severe pruriginous affection which mostly affects the inner surface of the thighs. occasionally the axillæ, and, in stout women, the regions under the breasts. It is in this stricter meaning that the term is used by medical men practising in the tropics.

The clinical features of the affection correspond to Hebra's ' eczema marginatum.' In a well-marked case the perineum, scrotum, and the inner surface of the thighs present large festooned patches, with an elevated abrupt margin ; the whole of the patches are bright red, or, in a later period, the margin only is red, while the rest of the patch is of a fawnish colour, or even of normal colour. The pruritus is unbearable. Owing to scratching, a secondary pyogenic infection or an eczematous-like dermatitis may develop. The disease, if not properly treated, is extremely chronic ; the condition improves during the cold season, but gets worse again during the hot months. Patients who suffer badly from dhobie itch may get almost well in a few days, without any treatment, on going to the hills ; on coming back to the plains the pruritus and all the other symptoms reappear. The affection has been known to last for many years. It is to be noted that after a time the eruption may spread to the other parts of the body—the abdomen, the trunk, legs, etc. In such situations it may develop in rings, or may form solid elevated dark red patches ; while the disease may be clinically indistinguishable from ordinary tinea circinata. It is to be noted, however, that the rings have generally a thicker edge, and the patches are coarser, of a deeper red colour, and larger than in ordinary tinea circinata. Mixed infections of tinea cruris and tinea circinata may occur, presenting the two

PLATE VII.

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TINEA CRURIS.

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fungi growing on the same patient, though in different regions of the body. Several such cases have been described by one of us.

Clinical Varieties.—The above description mostly applies to the disease as produced by *Epidermophyton cruris* and *Ep. perneti*. In the cases due to *Ep. rubrum* the affected parts often present from the very beginning an eczematoid appearance, the patches being reddish, and covered with pityriac squamæ, and often, especially at the edge, with minute bloody crusts. The edge is not so elevated as in the other types of *Tinea cruris*. This type of *T. cruris* has great tendency to spread to other parts of the body.

Communicability.—Tinea cruris is known in the East as dhobie itch, from the popular belief that it is contracted from linen which

FIG. 350. — TINEA CRURIS IN A EUROPEAN.
From the same case as the coloured plate.

has been contaminated while being washed by the dhobie (native laundryman). As to how far this belief is correct we are not in a position to say. We have never succeeded in finding the fungus in clothes newly received from the dhobie, either microscopically or by inoculating small portions of the linen in sugar media. We are, however, inclined to think that the popular belief may be to a certain extent correct. We have been told by old sufferers from dhobie itch, who used to be frequently reinfected, that on their ceasing to give their clothes to the dhobie, and having them washed in the house instead, the disease did not again affect them. In Colombo dhobies are in the habit of washing the clothes in a lake,

or in small pools of water more or less stagnant. It it certain that clothes belonging to infected persons are washed together with other clothes. Dhobie itch is very contagious; true epidemics occur in schools and among soldiers in barracks.

Diagnosis.—The diagnosis is easy in recent cases, the festooned appearance of the eruption, limited by a sharp, elevated, bright-red edge, being quite typical. In old cases, especially when secondary lesions due to scratching are present, the diagnosis may be very difficult, the affection being often mistaken for eczema.

In doubtful cases the microscopical examination will be of great help. It must, however, be noted that in old cases the fungus may be extremely scarce, the mycelium being practically absent, and only a few spores being found; it is well to take the scrapings for microscopical examination from the edge of the eruption. The differential diagnosis must be made from erythrasma, intertrigo, and eczema.

In *erythrasma* the patches have a fawnish or dark reddish colour, and present often a fine pityriasic desquamation; the eruption is not limited by a raised red edge; the fungus *Microsporoïdes minutissimus* is quite different from the fungi found in dhobie itch.

Intertrigo is very common in the tropics, especially in corpulent persons. The lesions are very superficial, have not a festooned contour, and the margin is not sensibly elevated; no *Epidermophyton* or *Trichophyton* like fungi are found. Saccharomycetic intertrigo is rare; there is no elevated margin, and the fungus is found to be a Saccharomyces (*S. samboni*).

Primary eczema of the scrotum, and of the skin of the thighs in contact with it, is as frequent in the tropics as it is in temperate zones. The eczema is generally of the moist variety; the moist surface, the absence of the festooned elevated margin, distinguish it from tinea cruris. As already stated, however, an eczematous-like dermatitis due to scratching often develops after a time on old dhobie itch lesions.

Prognosis.—If the affection is not energetically treated, it has a tendency to become very chronic and last for years. Occasionally the eruption spreads to the whole body, forming rings or solid patches; at other times a distressing dermatitis develops on old dhobie-itch patches, due to scratching. Tinea cruris may disappear during the cold season or when the patient goes to the hills, only to reappear as soon as the hot season commences. During the period of quiescence the skin of the affected regions often shows a brownish discoloration, furfuraceous, somewhat similar to erythrasma.

Treatment.—In tropical practice the usual treatment is a chrysarobin or goa powder ointment. Almost all the so-called dhobie-itch ointments sold as patent medicines contain goa powder.

Our usual line of treatment is as follows:

Mild Cases.—A resorcin salicylic ointment applied twice daily. Resorcin, ʒi.; Ac. salic., gr. x.; vaseline, lanoline, āā ʒiv. In some

cases we use Vleminckx' solution or lotio calcii sulphurati (slaked lime 4, sublimed sulphur 4, distilled water 35. Boil together, evaporate and filter to produce 20 of solution), pure or diluted.

Severe Cases.—We use a chrysarobin ointment (2 to 5 per cent.). The result is generally fairly successful. The patient should be informed that the medicine stains the linen, often irritates the skin, and that occasionally unpleasant evidences of absorption may take place. In obstinate cases we use local applications of turpentine-oil in the morning, and at night a resorcin salicylic ointment; if the parts are much inflamed, at night simply a boric ointment. This treatment gives good results. Turpentine is generally well borne, but patients often complain of a smarting and burning sensation a quarter or half an hour after the application. Exceptionally one meets with patients who cannot stand turpentine.

Cases complicated with Eczematous Dermatitis and Fissures.—In such cases one is apt to use a soothing treatment by pastes, lead lotions, etc., with the idea of first healing the eczematous lesions. In our experience, however, when the microscopical examination has shown the presence of the fungus, it is best, as a rule, to start an energetic antimycotic treatment at once. To the rhagades which so often develop in the inguinal regions we apply a solution of nitrate of silver (arg. nitr., gr. xv.; sp. æth., ℥i.). We touch with this solution the rhagades and the moist parts; this application is somewhat painful, but the pain soon disappears, and the fearful itching is relieved almost immediately; moreover, the nitrate of silver destroys the fungus. At night we apply a resorcin and salicylic ointment or paste all over the eruption;* as soon as the parts have become less moist, we begin the turpentine or the chrysarobin treatment. A precaution which must always be observed during and after the treatment to prevent reinfection, is to dust all the undergarments with antiseptic powder—for instance, Manson's powder (ac. bor., zinc. ox., amyli, āā. p. æq.); salicylic powder (ac. salicyl., gr. x.; talci venet., ℥i.); menthol powder (menthol, gr. v.; alcohol, q.s.; talci venet., ℥i.); dermatol powder (dermatol, gr. x.; ac. borici, ℥i.). It is advisable to wear small bathing-pants, which can be washed in the house.

TINEA ALBIGENA.

This trichophytosis was first described by Nieuwenhuis in Java. Nieuwenhuis' researches have been confirmed and enlarged by Jeanselme in Indo-China and in Siam; in the latter country the disease is known as *khi*. The disease is fairly common in the Malay Archipelago, and is occasionally met with in Ceylon.

Ætiology.—The affection is due to a *Trichophyton* first described by Nieuwenhuis—*T. albiscicans* (Nieuwenhuis) 1907.

* If the eczematous dermatitis is exceedingly moist and severe, instead of the resorcin salicylic paste, a lotion of resorcin 1 per cent., or glycerin, borax, and rose-water equal parts, should be used.

The spores in fresh preparations from scrapings are almost always absent ; the mycelium tubes are straight, occasionally showing a double contour ; they are often dichotomous. Nieuwenhuis has grown the fungus, using Sabouraud's sugar media ; the growth is very slow ; the colonies are whitish, and show a powdery surface.

Symptomatology.—The eruption generally affects the palms of the hands and the soles of the feet, but may extend to the forearms and legs, and may affect the nails. It begins with the appearance of small pruriginous spots on the palms and soles ; the epidermis becomes raised, and bullæ develop, containing at first clear serum ; the bullæ break, and the skin remains dry and peels

FIG. 351.—TINEA ALBIGENA.

off ; the parts remain tender, and there is desquamation and pruritus. A process of diffuse keratosis develops, the palms and soles becoming double their usual thickness ; deep fissures may be formed at the natural folds. Several horny semi-detached discs can often be seen at the dilated orifices of the sweat glands. The affection is very chronic ; it may begin in youth or in adult life. After some time a process of apigmentation of the skin sets in, white patches, leucoderma-like, developing, and extending often to the legs and arms.

Treatment.—Tincture of iodine and chrysarobin ointment (1 to 5 per cent.) answer fairly well, but the apigmented patches are not cured.

TINEA ALBA.

This tichrophytosis and its fungus were first described by Castellani in 1905. The disease is common in Ceylon, Southern India, and probably other parts of the tropics.

Ætiology.—The eruption is due to a *Trichophyton—T. macfadyeni* (Castellani) 1905—which is very abundant in the lesions. Mycelium and spores are of very small dimensions; the mycelial tubes are regularly shaped, do not show swellings, and are about $2\frac{1}{2}$ μ in breadth. The spores are numerous, but not grouped in clusters, and present a peculiar oval shape, the maximum diameter being $2\frac{1}{2}$ μ to $3\frac{1}{2}$ μ. The fungus is very difficult to grow; on the rare occasions when the inoculations are successful the growth is very slow; the colonies coalesce, forming a browny mass with deep furrows, and deeply rooted in the media.

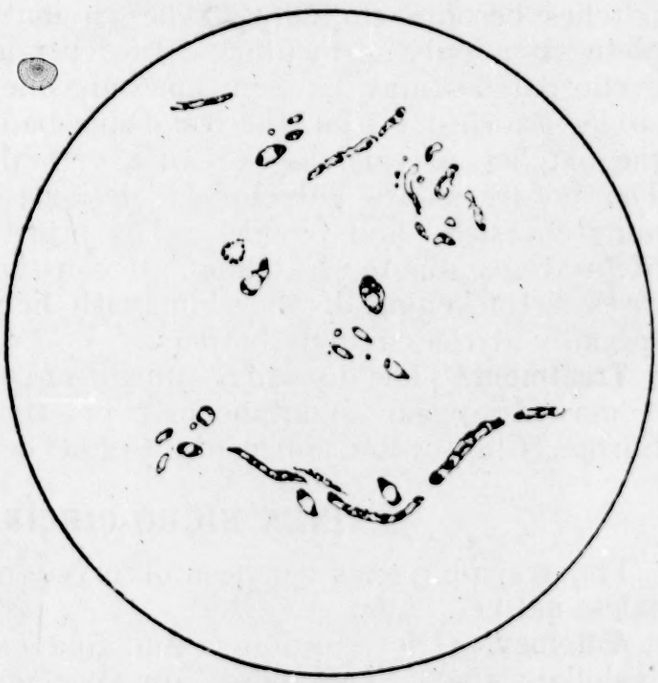

FIG. 352.—FUNGUS OF TINEA ALBA.

Symptomatology.—It may affect any region of the body, but is specially frequently noted on the arms and legs; it may occur on the face. White oval, roundish, or irregularly shaped patches are seen; the margins are slightly elevated, and may be dotted with minute papules. The surface of the larger patches presents a fine pityriasic desquamation. The course of the eruption is very chronic.

Treatment.—It is easily cured by the usual antiparasitic ointments, the best being chrysarobin ointment (2 to 5 per cent.).

TINEA SABOURAUDI.

This trichophytosis was first described by Sabouraud in patients returning from Indo-China, Japan, or Tonkin. We have seen a few cases in Ceylon.

Ætiology.—The disease is caused by the fungus *Trichophyton blanchardi* (Castellani) 1905—synonym, *T. sabouraudi* (Castellani) 1905*

* The term *T. sabouraudi* cannot be applied to this *Trichophyton*, as this name has already been used for another *Trichophyton—T. sabouraudi* (R. Blanchard) 1905.

—which cannot be grown on Sabouraud's media or any other media we have tried. Microscopically the mycelial tubes do not show a double contour, and are not very straight ; they are often banana-shaped. The segments of the mycelium are all separated ; the mycelial spores are roundish, and are shed without forming a filament by their union. They are of various sizes.

Symptomatology.—The eruption generally commences on the uncovered parts of the body, generally on the legs ; the patients often state that they think the disease is due to prolonged immersion in stagnant water. The affection begins with erythematous patches, the surfaces of which are covered with minute pityriasic squamæ. After reaching the diameter of about 1 or 1½ inches, the patches become circinate. The circination, however, is incomplete ; it is only segmentary. In dependent positions large polycyclic patches may be seen, but only one-half or one-third of the circles are clearly seen, the rest being badly defined. The base of the patches, at this stage, is of a very dark bistre-brown colour. The border shows polymorphic lesions, fine pityriasic squamæ, minute vesicles and papules. The pruritus is very marked, and excoriations, due to scratching, are constantly present. In chronic cases a thickening of the skin, with lichenification, takes place, specially at the circinate borders.

Treatment.—The disease is difficult of cure in the tropics, though it may disappear spontaneously on the patient proceeding to Europe. Chrysarobin ointment (1 to 4 per cent.) is the best treatment.

TINEA NIGRO-CIRCINATA.

This trichophytosis has been observed by Castellan iamong Sinhalese natives.

Ætiology.—The eruption is due to a *Trichophyton—T. ceylonese* Castellani 1908. The spores are very few in number, roundish, rather large (4 μ), and showing a double contour. The mycelial tubes are about 3½ μ in breadth, generally straight. The fungus does not grow on any of the ordinary or Sabouraud's media.

Symptomatology.—The eruption is found most frequently on the neck and scrotum, and consists of a few rings with thick, elevated margins, the encircled skin being black—much darker than the healthy skin—but not thickened nor presenting papules, vesicles, or pustules. The edge is thick, much elevated, of a dark colour, with the upper portion pinkish or occasionally covered by a dark crust. The eruption often heals spontaneously, leaving dark roundish patches at the previous seat of the lesions.

Prognosis.—The eruption may disappear spontaneously, and the treatment is easy.

Diagnosis.—The only dermatomycosis to which it has a slight resemblance is *Tinea sabouraudi.* The latter, however, is very chronic, and invades large portions of the body ; the rings are segmentary, not complete, and the edge is not so thick and elevated.

Treatment.—Tincture of iodine, freely applied, answers well.

PLATE VIII.

TINEA NIGRO-CIRCINATA.

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TINEA IMBRICATA.

Synonyms.—Tokelau (Samoa); Gogo (Marshall Islands); Pita (Bowditch Islands); Cascado (Moluc Island); Dermatomycosis Chronica Figurata Exfoliativa (Thomson); Herpes Farinosus (Ritter); Herpes Desquamans (Turner); Herpes de Manson (Roux).

Historical—Geographical Distribution.—The first reference to this disease is found in Albert's atlas, 1832. Fox, in 1844, described it under the name of 'gune.' He observed it in the Gilbert Islands, and 'gune' was the term used by the natives to indicate it (gune = skin). It is to Manson that we owe the first scientific description of the disease and the discovery of its fungus; he introduced the term 'tinea imbricata,' under which the disease is now generally known. Manson's researches have remained classical. Further researches were made by Turner, Köniğer, MacGregor, and more recently by Tribondeau, Nieuwenhuis, and many others. The disease is extremely common in Fiji and many other of the Pacific Islands; it is found in the Philippine Islands, in Southern China, Tonkin, Malay Peninsula, and Java. Lately the distribution of the disease has much extended; several cases have been seen by us in Ceylon and Southern India, in which countries the disease was believed to be non-existent. Cases have also been reported from Brazil and other parts of tropical America.

Ætiology.—The affection is caused by an *Endodermophyton* first discovered and described by Manson—*En. concentricum* (Blanchard) 1901; synonym, *T. mansoni* (Castellani) 1905.

Description of the Fungus.—In all the cases observed by us the characters of the fungus corresponded with those given by Manson, rather than with the descriptions of later observers, as Tribondeau. The fungus is very abundant, growing between the rete Malpighii and the more superficial strata of the epidermis. Fresh preparations of scales in liq. potass. show a diffuse mass of interlacing mycelium. The segments of the mycelium vary greatly in length; their breadth is between 3 and 4 μ. They are generally straight and of regular outline, not showing swellings or constrictions; the spores are rather large (4 to 5 μ), oval, or somewhat rectangular. Aspergillar-like fructifications have not been observed by us, and we have seldom succeeded in growing the fungus.* Strong says, also, that he has been unable to grow the fungus in the Philippine Islands. According to Nieuwenhuis, however, the fungus may easily be grown on various media. He states that the growth is slow, and that the colonies are thick, crateriform, of a dark brownish colour. By inoculating such cultures in a European, he reports that he has reproduced the disease.

Tribondeau describes aspergillar-like fructifications in the fungus, which he calls *Lepidophyton* (λέπις = scale; φυτόν = plant). He has not succeeded in growing it. Wehmer has confirmed Tribondeau's

* In the two cases in which, by special procedure, some growth appeared, it grew slowly, was scanty, and showed a whitish greyish appearance, and was mostly submerged.

results. In our experience, the fungus never shows aspergillar fructifications. In old scales kept in the laboratory for several weeks we have seen aspergillar-like fungi, but we believe them to be contaminations, as they are frequently found, for instance, in old blood-films, in old psoriasis scales, etc. It is not rare in the tropics to find aspergillar-like fungi even on the skin of normal persons, especially when they do not bathe frequently.

Symptomatology.—In a well-marked case the skin of practically the whole body is covered with round patches, each of which presents several concentric scaly rings. The scales are flaky, resembling tissue-paper, dry, of a dirty greyish colour, and slightly curled. If the scales are removed, rings of concentric circular dark lines remain visible. The number of rings forming the patch varies. Tribondeau states that they are not more than four; we have, however, frequently counted as many as eight and ten in the same patch. The eruption may spread to any part of the body, except, in our experience, the scalp. Though several authors state that the eruption never affects the face and axilla, and rarely the palms and soles, we have often observed it in such situations. It is also stated that the nails are not affected, though Manson, who first completely described the disease, said that the nails being affected was of frequent occurrence. Our experience tallies with that of Manson. The nails, when affected, are much thickened, have a rough surface and deep cracks. Scrapings examined in liquor potassæ show the fungus. The fungus never invades the hair-follicles. The general health is not affected, but the patients complain of the disfigurement and of the unbearable pruritus. The pruritus increases much, apparently, if the patient is given certain diets—for instance, dry-fish diet. In the hot season the pruritus is much more marked. The disease is very chronic, and very difficult to cure.

As regards the development of the disease, we can confirm Manson's description, one of us having made several experimental inoculations. The period of incubation varies between seven and ten days. After this time a slightly elevated brown patch is seen at the place of inoculation; the epidermis in the centre of the patch gives way, and a ring of scaling epidermis is formed; this ring expands towards the periphery. The scales are free towards the centre, attached to the sound epidermis at the periphery. While the ring expands towards the periphery, in the centre again a dark patch appears, which later breaks, and another ring is formed inside the first, and so on.

In all our cases the blood showed a certain degree of eosinophilia, the number of eosinophile leucocytes varying between 6 and 16 per cent. In some cases this eosinophilia was probably due to the presence of intestinal worms; the eosinophilia, however, was observed in some cases in which the microscopical examination of the fæces did not show any ova of worms. In very old cases the eosinophilia is more marked than in recent ones; in old cases signs of anæmia may be present.

PLATE IX.

TINEA IMBRICATA.

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Prognosis.—The general health is not affected. The patient complains of the disfigurement, which is very great, and of the pruritus, which in the hot season may be unbearable. The disease has no tendency to recover spontaneously; its treatment is difficult, and cases apparently cured often show a return of the eruption after a few months.

Diagnosis.—The disease, once seen, cannot be confused with any other dermatomycosis; its development in concentric rings, fringed with tissue-paper-like scales, is absolutely characteristic.

Treatment.—Every medical man practising in the tropics well knows how difficult is the treatment of tinea imbricata. It is easy to obtain a temporary improvement, and even a disappearance of the eruption; but as soon as the treatment is discontinued, the eruption, as a rule, starts afresh.

Strong iodine liniment, as recommended by Manson, or resorcin dissolved in tincture of benzoin (resorcin, ℥ii.; tr. benz., ℥i.), as recommended by Castellani, give, on the whole, the best results.

In the Colombo Clinic of Tropical Medicine the latter has made various experiments to test the efficacy of the various medicaments by applying simultaneously different liniments, ointments, etc., to symmetrical parts of the body, and comparing the result. According to his results:—

Sulphur has practically no effect whatever on the fungus.

Turpentine generally induces a slight improvement, some scales disappearing, and the skin becoming smoother; the improvement, however, is not permanent, and as soon as the turpentine application is discontinued the typical scales reappear.

Calomel and other ointments of mercurial preparations do not induce any improvement in the eruption.

Thymol and *Naphthol* ointments may cause a slight improvement.

Carbolic Acid and *Epicarin* ointments have no effect whatever.

Cyllin ointment (20 to 50 per cent.) may induce a temporary improvement.

Formalin is very effective for localized patches. The usual 40 per cent. solution is applied with care, treating each time a small portion of the eruption. Formalin often causes severe pain and a certain degree of inflammation, which is best relieved by applications of iced water. Soon after the application of formalin the patches become dark brownish, which colour lasts for a few days, when they clear. Care must be taken not to apply the formalin to too large portions of the skin, and not to repeat the application too often; otherwise a peculiar form of apigmentation, similar to leucodermic patches, may appear later on, to which disfigurement coloured patients strongly object.

Chrysarobin.—The repeated application of chrysarobin ointment (30 grains to 1 ounce of vaseline) may induce a strikingly rapid improvement in cases which are not of long standing. The eruption, however, recommences a few days or weeks after its apparent disappearance. Chrysarobin is a very toxic medicament; the patient must

be watched and the urine regularly examined. In one of our cases symptoms of absorption appeared after a single application.

Salicylic Acid and *Methyl Salicylate* have very little, if any, action on the fungus.

Tinctura Iodi and *Linimentum Iodi.*—Tinctura iodi, freely applied, induces a very marked improvement, which, however, is not permanent. Strong iodine liniment, as recommended by Manson, is most effective ; it cannot be used freely, however, on patients with a delicate skin, such as women and children.

Resorcin and Tincture of Benzoin.—Resorcin, alone or mixed with salicylic acid in alcoholic solution and in ointments, has very little efficacy. If, however, resorcin be dissolved in tinctura benzoini composita (60 to 120 grains of resorcin to 1 ounce of the tincture of benzoin), very good results are obtained ; it is now the routine treatment for tinea imbricata in the Colombo Clinic. It is to be noted that tincture of benzoin without resorcin has very little action on the eruption. The resorcin, dissolved in tincture of benzoin, should be applied freely once or twice daily on the affected regions. If the whole body be affected, one day one half is painted, and the other day the other half, alternately. The treatment must be continued for several weeks. Once or twice a week the patient is given a very hot bath, and scrubbed all over with sand-soap. Symptoms of absorption are rare ; it is always prudent, however, to proceed at first with care, as it is well known that individuals may be met with, though rarely, showing idiosyncrasy for resorcin.

TINEA INTERSECTA.

This dermatomycosis and its fungus were first described by Castellani in 1907. It occurs in Ceylon and Southern India.

Ætiology.—If a portion of one of the brown patches or a scale be removed and treated with liquor potassæ, the fungus is easily detected. The fungus (*Endodermophyton castellanii* Perry 1907) grows between the superficial and the deep strata of the epidermis. It is present on the inner surface of the scales, but not on the external surface. A very remarkable fact is the extreme rarity of free spores ; in fact, in several cases one does not succeed in finding spores. The mycelium is fairly abundant, though far from being so abundant as in tinea imbricata. It is composed of long, straight, articulated threads, which are sometimes dichotomous, the breadth being between 3 and $3\frac{1}{2}\,\mu$. No aspergillar fructifications nor clusters of spores are seen. So far attempts at growing the fungus have failed.

Symptomatology.—The eruption begins with small oval or roundish, very slightly elevated itching patches, generally situated on the arms, legs, chest, and back. The margins of these dark spots are at first slightly elevated, and dotted often with minute dark papules. The patches are dark brown in colour, much darker than the surrounding skin, and present a smooth, tense surface at

PLATE X.

TINEA INTERSECTA (FOREARM).

Johnston & Sons Lith, Edin

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first ; they increase in size slowly, and some coalesce. After a certain time the surface of the patches is no longer tense ; it becomes somewhat shrivelled and dry ; superficial cracks appear in it, so that white lines are visible intersecting the brown surface. Later the cracks become deeper, the epidermis splits, and several flaky, curled-up scales, whitish inside and dark on the outer surface, are seen ; the scales are often removed by friction, and whitish roundish patches only remain. The eruption never develops in concentric rings like tinea imbricata ; the patches remain isolated or fuse together, forming irregular larger patches. Some patches may disappear spontaneously after a time. The general health of the patient does not seem to be affected. In some patients there is a slight degree of eosinophilia.

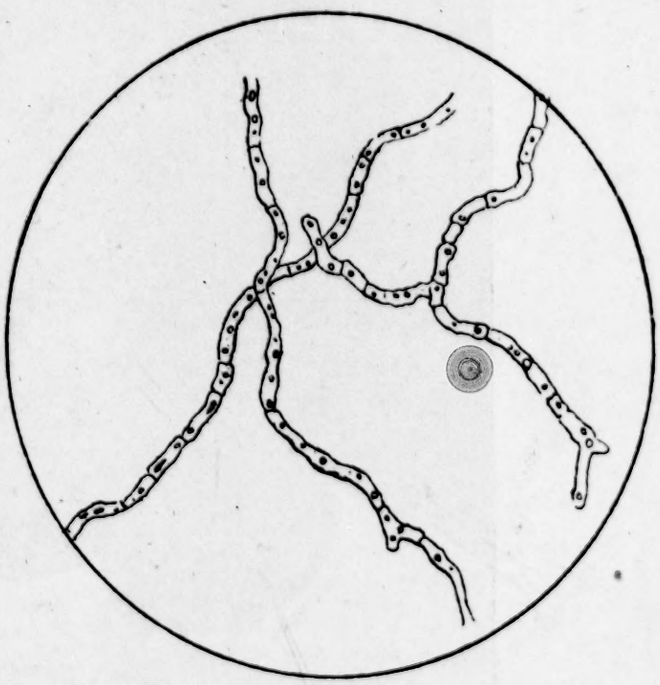

FIG. 353.—FUNGUS OF TINEA INTERSECTA.

Diagnosis.—When the eruption is in the very first stage it might be mistaken for a form of pityriasis versicolor. In pityriasis versicolor, however, the epidermis does not split ; moreover, in tinea intersecta the fungus is not found on the surface : it grows between the superficial and deep layers of the epidermis. Tinea imbricata begins in a manner somewhat similar to tinea intersecta, dark brownish patches being present, and the fungus in both eruptions growing between the superficial and deep layers of the epidermis. In contrast to tinea imbricata, however, the eruption of tinea intersecta never develops in concentric rings ; is far less severe, as patches may heal spontaneously ; and is cured without much difficulty.

Treatment.—Tincture of iodine and the usual antiseptic ointments, such as chrysarobin (2 to 5 per cent.), answer well.

TINEA FLAVA (*vide* Plate XI.).

Synonyms.—Tropical Pityriasis Versicolor of the old authors, Microsporosis Flava (Castellani), Achromie Parasitaire (Jeanselme), Pityriasis Versicolor Flava (Castellani), Achromia Squamosa (Crocker).

This dermatomycosis is extremely common in all tropical countries, and especially so in Southern India, Ceylon, Malaya,

Java, Indo-China, and China. By many authors it has been, and is still, confused with the ordinary pityriasis versicolor of temperate zones; the investigations of Jeanselme and Castellani, however, have clearly proved that it is a different affection.

Ætiology.—The affection is due to *Malassezia tropica* Castellani 1905. The mycelial threads are generally thick, with numerous swellings, constrictions, and other irregularities in their shape. The spores are roundish or oval (3·50 to 4·50 μ), and have a double

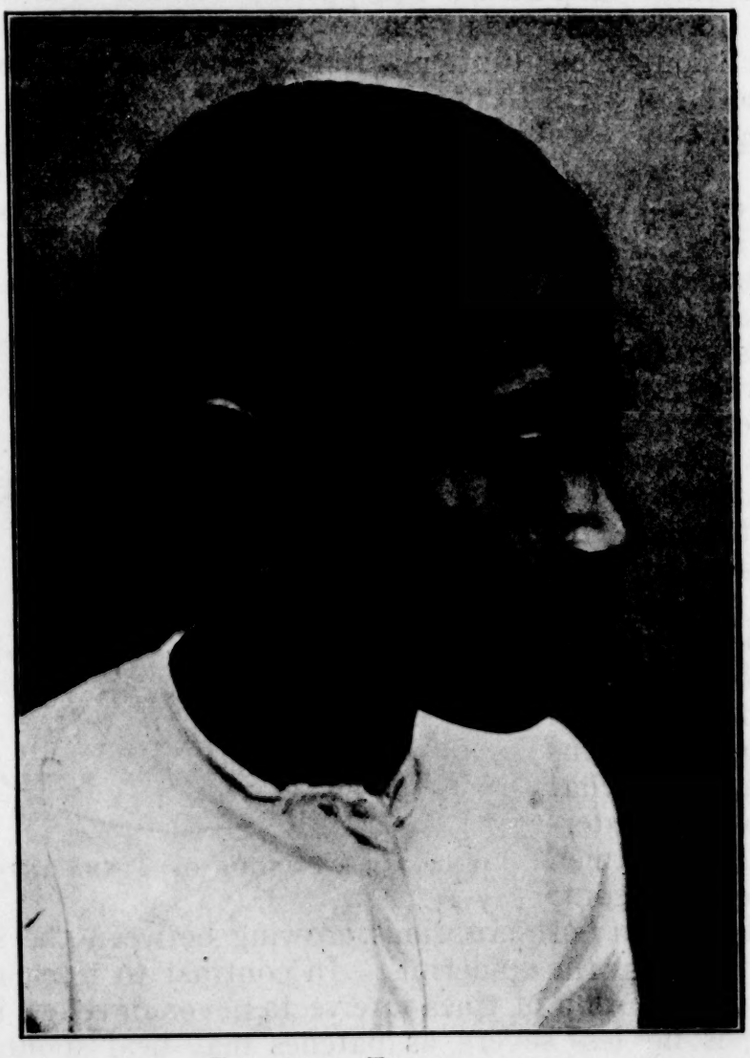

FIG. 354.—TINEA FLAVA.
On the face of a Sinhalese.

contour. In recent cases the fungus is abundant, with plenty of mycelium and spores which often run into clusters. In old chronic patches the fungus becomes very scanty; the spores are not numerous, and generally do not collect in clusters; the mycelium is very scanty, and is even more irregular in shape than it is in recent patches (degeneration forms of the fungus).

Symptomatology.—The affected parts are yellowish, of much lighter colour than the surrounding healthy skin; the yellow colour

may be of various tinges, from dark, deep orange-yellow in some cases to very light canary-yellow in others. The patches are of various sizes, generally roundish, smooth, sharply defined, with margins not elevated, or only slightly so. Sometimes the patches are irregularly festooned, and may encircle an area of healthy skin. Occasionally the encircled healthy skin appears to be intersected by many yellowish, ribbon-like lines originating from the surrounding yellow patch. The regions more frequently affected are, in order of frequency, the face, neck, chest, and abdomen. Large portions of the body may be involved. There is no pruritus. The patches are not desquamating, or only very slightly so. The course of pityriasis flava is very chronic. In the natives of the lower classes it appears in childhood as tiny spots on the face and chest, spreading slowly during years; they may coalesce, covering practically the whole of the face and chest. One is occasionally surprised to see a native whose face and chest are quite light in colour; on closer examination, it may be found that this lighter appearance is due to a diffuse, very light-coloured form of tinea flava, covering the whole of the face, neck, and chest. In Ceylon native women, when the patches of Tinea flava are small, light, and situated on the face, they are considered as beauty-spots, and are highly appreciated by the ladies and their admirers. Such patches are called in Sinhalese 'alu-hama,' which means ashy skin (*alu*, ash; *hama*, skin). There is also another word used by native poets for such conditions—'gomera,' which means skin dotted with beauty-spots. The disease, which is extremely common, attacks mostly natives, but occasionally Europeans also. In Europeans the patches are yellowish-reddish or pinkish (tinea rosea), and may be due to different strains of *M. tropica*.

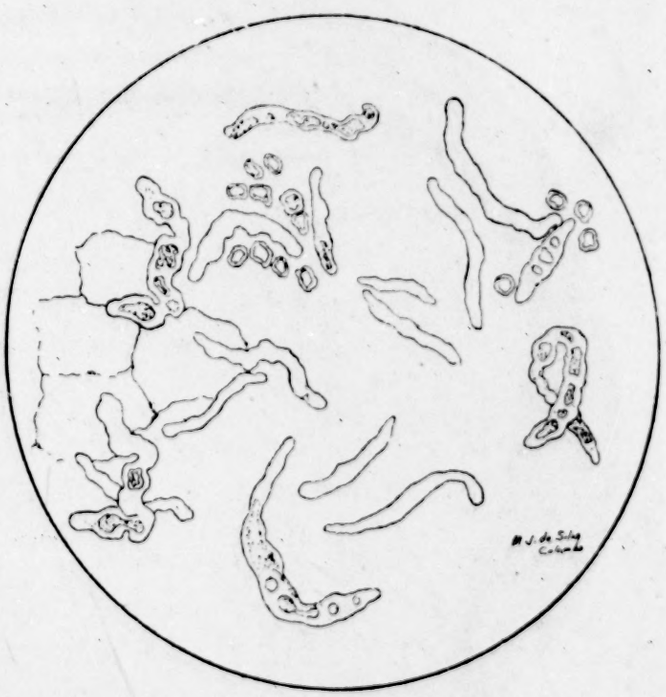

FIG. 355.—FUNGUS OF TINEA FLAVA.
(From a specimen stained by the Morris-Walker method.)

Prognosis.—The disease is very chronic, has no tendency whatever to spontaneous cure, but the general health is not affected.

Diagnosis.—*Pityriasis versicolor* of temperate zones is not of so light a tinge as tinea flava, never attacks the face, and is curable

with the greatest facility; while tinea flava affects the face more frequently than any other part of the body, and is curable only with difficulty.

Tinea Alba.—Occasionally there may be some difficulty in distinguishing tinea flava of a light variety from tinea alba. In contrast to tinea flava, the patches of tinea alba are not smooth, and the fungus (*Trichophyton macfadyeni*) shows spores of a peculiar characteristic oval shape.

Tinea Flava and *Pinta* are easily distinguished by the characters of their respective fungi, the fungus found in pinta never having the characters of a Malassezia.

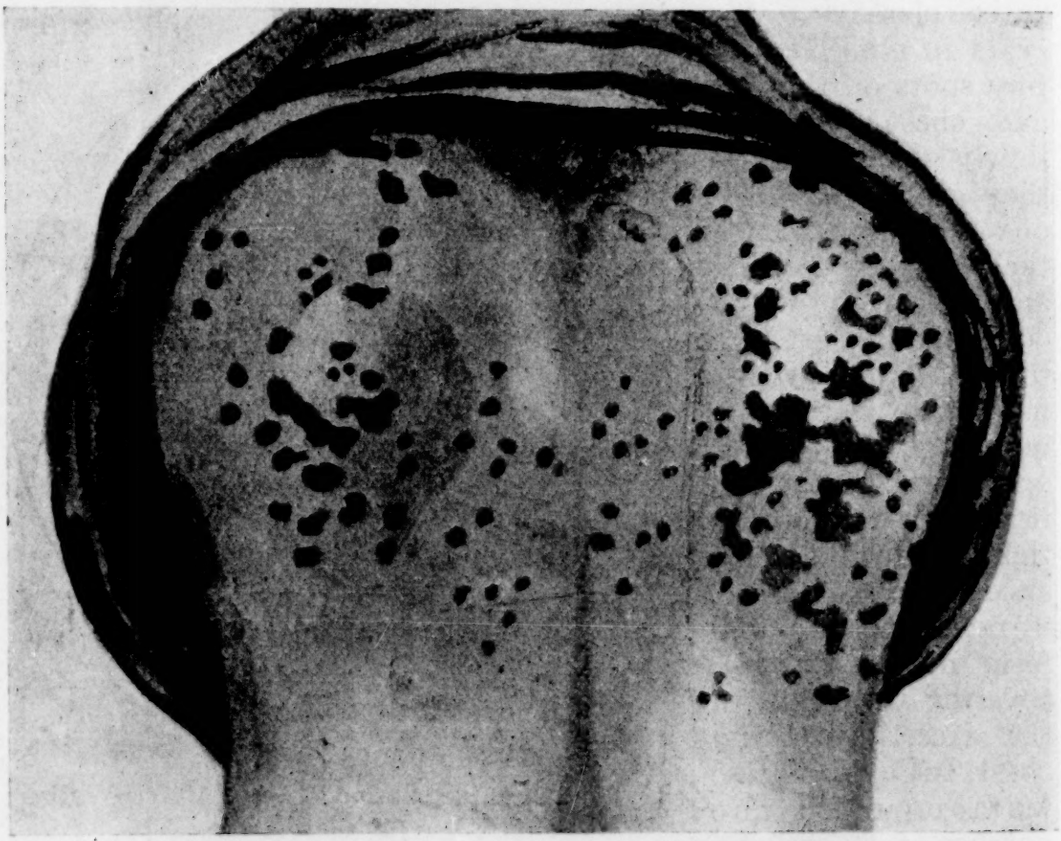

FIG. 356.—TINEA FLAVA ON THE BACK OF A EUROPEAN.

Leucoderma patches have a characteristic dead-white colour, are often surrounded by a hyperpigmented border, and no fungus is found.

In *Circumscribed Scleroderma* (Morphœa) the patches may present a peculiar yellowish tinge, which in coloured patients may resemble tinea flava. In tinea flava, however, there is no change in the texture of the skin, which is still pliable, and does not exhibit the peculiar parchment-like feeling of scleroderma. The microscopical examination will clear the diagnosis in any doubtful case.

In Europeans the reddish-yellowish variety of tinea flava might, on superficial examination, be mistaken for a form of *Seborrhœa*

corporis. The microscopical examination will clear the diagnosis, no fungus being found in seborrhœa corporis.

Treatment.—Tinea flava shows no tendency to spontaneous cure, unless the patient moves to a cold climate. The treatment is difficult. Turpentine applied daily, followed by a naphthol or epicarin ointment (2 to 5 per cent.), or a salicylic-resorcin ointment (resorcin ʒi., acidi salicylici gr. x., vaselini ʒi.), is often successful, but the treatment must be continued for months. It is to be noted that in several cases the fungus of tinea flava has apparently a deep permanent disturbing action on the pigmentation processes of the skin, as, even when the fungus has been destroyed, the patches may remain of a lighter colour than the surrounding skin for a long time, though ultimately they become again normally pigmented.

TINEA NIGRA.

Synonyms.—Pityriasis Nigra (Castellani), Microsporosis Nigra (Castellani).

This affection is fairly common in India, Ceylon, Java, Federated Malay States, and China. The first account of this, or a very similar, dermatomycosis was published by Manson in China in 1872. Manson's observations, however, were forgotten, as they were not quoted by him in his subsequent works. Castellani, in 1905, redescribed the disease in Ceylon, and succeeded in growing the fungus which he called *Foxia mansoni*.

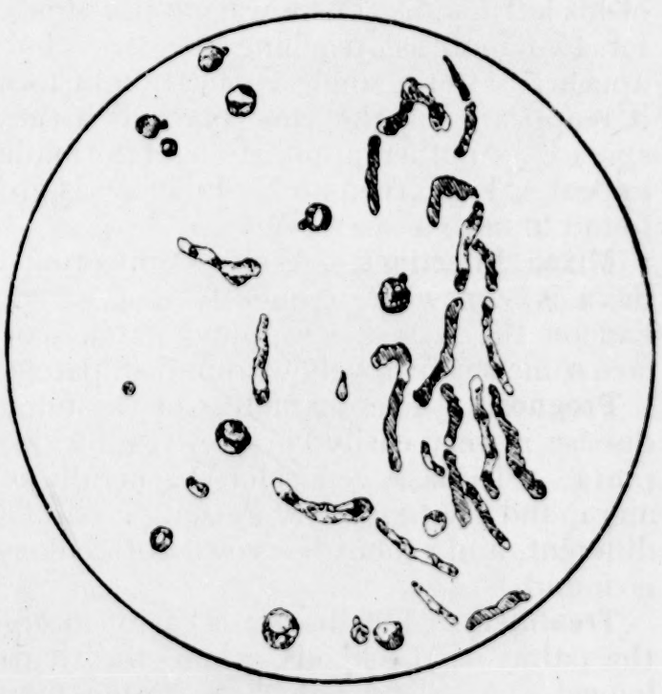

FIG. 357.—FUNGUS OF TINEA NIGRA.

Ætiology.—The affection is caused by a fungus of the genus *Foxia — F. mansoni* Castellani 1905. The fungus is found very abundantly in the lesions; the mycelial articles are rather short—18 to 20 μ in length, and $2\frac{1}{2}$ to $3\frac{1}{2}$ μ in breadth. Sometimes they may be irregular in outline, bent, banana-shaped. The spores are globular, and most of them very large—5 to 8 μ. They are frequently arranged in clusters.

The fungus is easily cultivated by inoculating scrapings of the affected patches on maltose agar. After two to four days roundish hemispheric colonies appear, which are black, but at first have usually a greenish tinge, and may present at the periphery some radiating, delicate, pale greenish hyphæ.

These colonies may remain separate or more often gradually coalesce into a jet-black knobby mass, deeply rooted into the medium.

The fungus grows well, though less abundantly, on the other sugar agars, and also on ordinary agar. In *broth* and *peptone-water* the growth is very slow, and takes place at the bottom of the tubes, with formation of a black or greenish-black sediment.

The *optimum temperature* for the growth of the fungus is between 30° C. and 32° C.; above 35° C. and under 25° C. the growth is much slower, and may be nil under 20° C.

Symptomatology.—The affected parts are of a black, dull, lustreless colour, much darker than the surrounding dark, healthy skin of the native. The patches may be small, roundish, and separated from one another, or may coalesce; the patches are often slightly elevated, and may present a slight desquamation. Little, if any, pruritus is present. The face is not usually affected, though the eruption may be found on practically any other region of the body. The neck and upper portion of the chest are apparently the regions most frequently affected. Tinea nigra usually attacks natives only. We have, however, seen it also in one of our European patients, who went for a pleasure trip to Burma, where he remained about a month. On coming back to Ceylon, he noticed a small, roundish, very slightly elevated, non-desquamating, black patch on the palm of his left hand. There was no pruritus. The patch spread slowly for two months, reaching the size of a sixpenny-piece. It disappeared after a single application of formalin; three months later it reappeared in the same place as a tiny black dot, which slowly spread. Another application of formalin caused it to again disappear. From the patch a fungus was grown identical with the one found in native cases.

Mixed Infections.—A mixed infection of tinea nigra and tinea flava is somewhat frequently met with. Several of our patients had on the neck a few round patches of tinea nigra, and on the face some smooth, yellow, roundish patches of tinea flava.

Prognosis.—The characters of the fungus, and the fact that the disease is very easily curable, readily distinguish tinea nigra from pinta. Pityriasis versicolor is generally of lighter colour than tinea nigra, and the fungus (*Malassezia versicolor*) is morphologically very different, and cannot be grown. In chloasma bronzinum no fungus is found.

Treatment.—The disease is easily curable, except when it attacks the palms of the hands, where the treatment must be more prolonged. A salicylic-alcoholic lotion (2 per cent.), followed by a resorcin ointment (resorcin, ʒi.; vaseline, ℥i.), answers well. When the patches are small, pure formalin may be used with care.

ERYTHRASMA.

This affection is frequently met with in the tropics, and is common on the continent of Europe, though apparently rare in America.

PLATE XI.

TINEA FLAVA ON THE FACE AND
TINEA NIGRA ON THE NECK.

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To face page 1092.

Ætiology.—It is caused by a fungus discovered by Burckhardt in 1859—*Microsporoides minutissimus*. This hyphomycete is very delicate and slender, less than 1 μ in breadth ; is found in the superficial horny layer of the affected parts. Ducrey and Reale claim to have succeeded in cultivating it, but their results have not been confirmed.

Symptomatology.—The eruption generally affects the genito-crural and axillary regions, but may occasionally spread to other parts of the body. It is characterized by the presence of brownish-reddish patches, rounded or irregularly shaped, but with well-defined borders. The borders are not elevated ; the surface of the patches appears slightly furfuraceous, and has often a somewhat greasy feeling. There are no subjective symptoms, except occasionally slight itching.

Diagnosis.—Erythrasma is easily distinguished from tinea versicolor and tinea flava by the reddish tinge generally present ; by the characteristic difference of its sites of development, and by the microscopical examination which will reveal the presence of *Microsporoides minutissimus*, a fungus morphologically very different from *Malassezia versicolor* or *M. tropica*. The differential diagnosis from tinea cruris has been discussed in this chapter under the heading Tinea Cruris.

As first noticed by Manson, after tinea cruris has been cured, the genito-crural region may in some cases present for years a peculiar brownish discoloration, and be slightly furfuraceous—a condition resembling erythrasma ; in such cases neither *Epidermophyton cruris* nor *Microsporoides minutissimus* will be found.

Treatment.—Washing the parts with ordinary soap and warm water, carbolic, tar, or sand soap, and then regularly applying a resorcin-salicylic ointment, will soon cause the eruption to disappear. Instead of the ointment, a hyposulphite of soda or sulphurous acid lotion may be used.

BLASTOMYCOSIS.

Synonyms.—Saccharomycosis Hominis, Oidiomycosis, Dermatitis Blastomycotica, Blastomycetic Dermatitis.

Historical and Geographical.—Gilchrist, in 1894, first described yeast-like organisms in sections taken from a scrofuloderma-like eruption. In the same year, independently, Busse published a case of a pyemia-like condition due to a *Saccharomyces*. The disease has been investigated chiefly by American observers, among whom Ricketts, Ormsby, Hyde, Montgomery, and Pusey may be mentioned. The malady occurs in the tropics, and one of us has reported several cases from Ceylon, while Phalen and Nichols have described numerous cases from the Philippine Islands.

Ætiology.—The fungi found belong to the genera *Saccharomyces*, *Cryptococcus*, *Endomyces*, and higher, not yet well-determined fungi,

all of which are apparently capable of inducing identical clinical conditions. In the tissues all the organisms exist as yeast-like oval or roundish cells. Among the organisms which cause the disease, four types (Ricketts) may be distinguished :

1. Blastomycetoid or yeast-like type : reproduction by budding ; in cultures only oval or roundish cells are seen, while mycelial tubes are as a rule absent.

2 Cryptococcus-like type : reproduction by endosporulation within the tissues.

3. Endomyces-like type : the cultures present abundant submerged mycelium, which breaks up into chains of endoconidia ; proliferation by budding is rare.

4. Hyphomycetoid type : cultures present aerial hyphæ and submerged mycelium ; proliferation by gemmation occasionally seen. There are many transition forms between these four groups.

FIG. 358.—BLASTOMYCOSIS OF LEG.

Histopathology.—There is marked proliferation of the epithelial layers, with elongated, irregularly shaped downgrowths into the corium. The cells of the rete are swollen, and there is, between the cells, a polymorphonuclear leucocytic infiltration. Here and there minute miliary abscesses are present ; it is in the miliary abscesses that the organism is mostly found. The corium presents a general cellular infiltration made up of polymorphonuclear leucocytes and young connective-tissue cells. Occasionally a few giant cells may be seen. The vessels are dilated and their walls thickened.

Symptomatology.—The disease is characterized by the presence of elevated warty patches showing, especially at their margins, minute epidermal abscesses. The eruption may be gyrate. The lesions at a later stage may become ulcerated, the process of ulceration generally beginning at their centre. There is very little or no pain, and very slight or no pruritus. The lesions may heal spontaneously, leaving, as a rule, soft smooth scars. Occasionally the affection recommences after a time in the scar. The lymphatic glands are seldom involved. In some cases subcutaneous abscesses and gumma-like swelling may be formed ; all regions of the body may be affected. The course is very chronic.

Diagnosis.—The disease has been often confused with tuberculosis verrucosa, with a syphilide, with an epitheliomatous lesion, and, in the tropics, with atypical frambœsia and even ringworm. The microscopical examination and cultivation of scrapings, or, better, of the pus of the miliary abscesses present in the lesions, will be necessary to clear the diagnosis. A droplet of the pus, or a minute portion of teased tissue, is placed on a slide with a drop of a 30 per cent. solution of potassium hydrate, and a cover-glass is placed on the preparation ; after about half an hour in a temperate climate, and generally a few minutes only in a tropical climate, the tissue and pus cells are disintegrated by the potash solution, while the organisms, being resistant, can be easily seen. Cultures should also be made from the pus. It is important to note that yeast-like organisms may be frequently found as saprophytes on the surface of various ulcerated skin lesions, which have nothing to do with true blastomycosis.

Prognosis.—The disease very rarely heals spontaneously. The general health is not much affected, but the patients complain of the disfigurement. Occasionally the organisms from the skin lesions enter the general circulation, and a condition similar to pyæmia develops. Cases of systemic blastomycosis terminating fatally, without any skin lesion, have also been described.

Treatment.—Potassium iodide, given in large doses, has a beneficial effect, though it is not so efficacious as in sporotrichosis. The application of Röntgen rays to the lesion is useful. In mild cases the local application of various disinfectants—*e.g.*, perchloride of mercury (1 in 1,000), dilute tincture of iodine, etc., may bring about a cure.

SPOROTRICHOSIS.

Schenk, in 1898, described a case of multiple chronic abscesses in the pus of which a *Sporotrichum* was found. Hektoen and Perkins reported two similar cases also in the United States in 1900. De Beurmann published in 1903 a case of similar nature in France. Beurmann and Gougerot, in 1906 and 1907, published several cases, and investigated the subject of human sporotrichosis bacteriologically and histologically, as well as clinically. Their researches have been confirmed by Gaucher and Monier-Vinard, Duval and Fago, Vaquez, Bonnet, Lanbry, and Esmeni. Cases have been reported recently from the tropics by Lutz and Splendore in Brazil, and by us in Ceylon. Clair has observed the disease in Arab stokers on board some steamers of the Messageries Maritimes Company.

Ætiology.—The fungi found belong to the genus *Sporotrichum*. *S. shenki* has been observed in the cases in North America ; *S. beurmanni* in the European and Brazilian cases ; *S. indicum* in the Ceylon cases. These fungi are morphologically very similar. In the human lesions the fungus appears morphologically as a yeast, and is very scarce. In cultures mycelial threads and numerous spores are seen. The spores are ovoid, 5 to 6 μ in length by 3 to 4 μ

in breadth. The mycelial filaments are very slender (2 μ) in *S. beurmanni* and *S. shenki ;* somewhat broader (2½ to 3 μ) in *S. indicum.* These fungi grow easily on the ordinary culture media, best of all on Sabouraud's pepton-glucose-agar. Colonies develop from the fourth to the tenth day as small white points, surrounded by a delicately rayed aureola of whitish colour. They gradually increase in size, coalesce, become convoluted, and take a dark greyish, brownish, and even black colour. These fungi live apparently saprophytic on vegetables (lettuce-leaves, and other kinds of vegetables used as salads) and on insects (flies, caterpillars, larvæ). According to De Beurmann, infection takes place by contact with unclean vegetables.

The rat, mouse, monkey, cat, and very young guinea-pigs are all more or less susceptible, and may be infected by subcutaneous or intraperitoneal inoculation. The rat is the most susceptible animal. In this animal Lutz and Splendore have described a spontaneous sporotrichosis due to a *Sporotrichum* apparently identical with *S. beurmanni.* The affection has also been observed to occur spontaneously in the dog (Gougerot and Caravan) and in the mule (Fonteynot and Carongeon) in Madagascar.

Histopathology. — The histopathology of the cases due to *S. beurmanni* has been investigated by Beurmann and Gougerot. We have come to similar results in the cases due to *S. indicum.* The lesions present three principal types of reaction : (1) An epithelioid type, with presence of giant cells—this corresponds to the tuberculoid type of De Beurmann and Gougerot ; (2) a lympho-connective tissue or syphiloid reaction ; (3) a polymorphonuclear or a ecthymatiform type.

Symptomatology.—In a well-marked case, several gummatous-like swellings, situated in the subcutaneous tissue, are present on various parts of the body—the arms, legs, and trunk. The size varies from that of a small pea to that of an orange. On palpation, they are hard, resistant at first ; later they soften, the skin becomes reddish or violaceous, and after a time perforates. From the fistulous opening a yellowish homogeneous pus is slowly evacuated. In some cases the suppuration ceases, granulation sets in, and a coarse cheloid-like scar remains. In other cases the fistulous opening enlarges, and a crateriform ulcer, with often a fungating fundus, develops. The lymphatic glands may become affected. The course of the disease is very chronic. In some cases deep gummata develop under the periosteum of various bones, and in the muscles. Large granulating ulcerations may form in the bucco-pharynx and larynx. The general health, as a rule, is not much affected.

Diagnosis.—In our experience, it is practically impossible in most cases to distinguish the affection clinically from lesions of tubercular, syphilitic, or frambœtic origin. The diagnosis is easily made by bacteriological methods. The simple microscopical examination of the pus of the abscesses, or scrapings of the ulcers, is not sufficient, as the fungus is extremely scarce. Cultivation must be

resorted to. A few glucose-agar tubes are inoculated in the usual way, and kept at room-temperature without capping. After four to ten days the first colonies of *Sporotrichum* will appear.

Treatment.—Potassium or sodium iodides in full doses (15 grains three to four times daily) induce a rapid disappearance of all the lesions.

INTERTRIGO SACCHAROMYCETICA.

Synonym.—Intertrigo Blastomycetica.

Remarks.—Cases of this affection have been observed by Castellani in Ceylon, and one similar has been reported by Whitfield in England. The affection is apparently rare. It generally attacks the scroto-crural and axillary regions. The affected skin is red, and there may be slight exudation. The borders of the eruption are fairly well marked, but never elevated. In most cases there is not much itching, and the affection may recover spontaneously.

Ætiology.—In scrapings a Saccharomyces (*S. samboni* Castellani 1907), which is easily cultivated on sugar media, is found.

Treatment.—The treatment consists in washing the affected parts with potassium permanganate lotion, 1 in 4,000 ; resorcin, 1 in 100 ; followed by the application of powders of boric acid ʒi., talci ʒi. ; or salicylic gr. x., talci ʒi.

ASPERGILLOSIS AND PENICILLIOSIS OF HAIRY PARTS.

The affected hairs—generally those of the beard and moustache, occasionally of the axilla—present dirty greyish or whitish punctiform formations, which on microscopical examination are seen to consist of penicillar or aspergillar fungi (*Penicillium barbæ*, *Aspergillus barbæ*). Occasionally both types of fungi are found on the same patient. The affection is very chronic. The simplest method of treatment is by shaving, and afterwards using regularly a medicated soap, such as carbolic soap, tar soap, or sulphur soap. If the patient does not wish to shave his beard, turpentine may be tried.

In natives who do not bathe frequently, such as old persons and beggars, the skin presents often large dark patches due to accumulated dirt, in which aspergillar and penicillar fungi are often present, living saprophytically. This condition has nothing to do with pinta, as a thorough scrubbing with soap will remove the dirt and the aspergillar and penicillar fungi which may be present.

PINTA.

Synonyms.—Mal de los Pintos, Mal del Pinto, Caraate, Tina, Quirica, Pannus Carateus (Alibert), Tache Endémique des Cordillières (Alibert), Lota, Cativi.

Definition.—The term ' pinta ' does not indicate a single disease, but a group of closely allied dermatomycoses characterized by the presence of patches of various colour, due to different species

of fungi of the genera *Aspergillus*, *Penicillium*, *Monilia*, and *Montoyella*.

History.—The disease first began to draw the attention of medical writers in the eighteenth century, though it was apparently well known to the inhabitants of the affected regions since remote times, as it is found to have formed the subject of prayers and supplications used by the Aztecs centuries before the Spanish Conquest.

A short description of the malady is found in the Encyclopædia of Polanko, of Mexico, in 1760 ; and in Juan de Velasco's ' Historia,' in 1789, in Columbia. Velasco believed the malady to have been imported by African slaves. A fairly complete description is given by Alibert, in 1829, under the name of ' tache endémique des Cordillières,' or ' pannus carateus.' Among the modern authors, the clinical and pathological investigation of Gomez, Uribe, Vribechyel, Iryz, Ruiz y Sandoval, Gastambide, may be mentioned.

More recently the investigation into the ætiology of pinta by Montoya has been of the greatest importance.

Climatology.—Pinta is practically limited to Tropical America, where it is found in Venezuela, Peru, Chili, Central American States, Mexico. Cases have been reported from Brazil. It is extremely common in Columbia, where, according to Montoya, 4 per cent. of the total population is affected. There the patient affected with the disease is called ' caratejo.' The disease is not equally distributed ; in each country there are localities where the disease is common, while other districts are almost unaffected. In Columbia it is the northern province of Santander which is more particularly affected ; in Mexico the disease is most frequently found in the provinces of Tabaxo, Chiaspas, Valladolid, Michoacan.

A few cases of pinta have been reported from Egypt by Madden, Goodman, and Sandwith, and previously Legrain described somewhat similar cases from Tripoli and the Sahara. Legrain, however, did not find any fungus. A few isolated cases have also been reported from the Gold Coast, and others from the Philippine Islands by P. G. Woolley. In Ceylon and India only imported cases are seen.

Ætiology.—Previously to Ruiz y Sandoval and Montoya's investigations the disease used to be ascribed to many different causes. Some authors believed it to be due to the mineral salts (sulphates) contained in the waters of the mines and other localities where the malady is endemic ; others considered it to be due simply to insanitary conditions, insufficient food, and a hot and damp climate ; others, again, believed the affection to be induced by the action on the skin of volcanic cinders ; while, according to some authorities, the malady was a hereditary complaint.

Ruiz y Sandoval, in Mexico, first detected the parasitic nature of pinta. He believed there was only one species of fungus to be found in the affection, and that the different colours of the patches were due to the different depth the fungus was growing in the

various strata of the epidermis. Montoya's classical researches in 1898 clearly showed the plurality of species and genera of the fungi found in the disease, and demonstrated that each variety of pinta is due to a different fungus. More than twenty different species were found by him.

In the present state of our knowledge of pinta, it is impossible to give a satisfactory classification of these fungi. The principal ones may be collected into the following groups:

I. Fungi of genus *Aspergillus: Aspergillus pictor* Blanchard 1895, and several other species. *A. pictor* is found in the pure violet variety of pinta; the other species are observed in the pure blue and bluish and violet-black varieties, as well as in a form of the red variety. Several of these species are not in reality true *Aspergilli*, as they possess organs of fructification intermediate between those of the genus *Aspergillus* and those of the genus *Penicillium*.

II. Fungi of genus *Penicillium: Penicillium montoyai* Castellani 1907, and several other species. They are found in some greyish-violet varieties of pinta.

III. Fungi of genus *Monilia: Monilia montoyai* Castellani 1907. Found in some cases of white pinta.

IV. Fungi of genus *Montoyella: Montoyella nigra* Castellani 1907. Found in one variety of black pinta. *M. bodini* Castellani 1907. Found in a red variety of pinta.

The term *Aspergillus* (*Trichophyton*) *pictor*, introduced by Blanchard in 1895, when the plurality of species of the fungi found in pinta had not yet been demonstrated, is now used in a restricted sense to indicate the *Aspergillus* found in the pure violet variety of the disease.

Montoya believes that the fungi found in Columbian pinta, or caraate, are different species from those found in Mexican pinta.

Appearance of the Fungi in Fresh Preparations.—Scrapings from the patches examined in liquor potassæ show in most cases between the epithelial cells long dichotomous mycelial threads, from which shorter and thicker branches take origin at various points. These thicker branches terminate in comparatively large fructifications. The morphological characters of these fructifications vary according to the species and genus of the fungus present. They may be typical aspergillar or penicillium-like fructifications, or they may show intermediate characters between those of *Aspergillus* and *Penicillium*. In many cases the fructification organ is represented by a pear-shaped or triangular formation, surmounted by five to six rods (sterigmata), each of which supports a string of five to six spores. The number of these spores, however, may vary. They are globular, have a smooth surface, show a double contour, and their diameter is much larger than that of the mycelial tubes.

In the cases where the fungus present is a *Monilia* or a *Montoyella*, such or similar fructifications are absent, and only mycelial tubes and some scattered spores are seen.

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In the cases where the fungus present is a *Monilia* or a *Montoyella*, such or similar fructifications are absent, and only mycelial tubes and some scattered spores are seen.

Cultures.—The various fungi found in pinta are easily cultivated, the best medium being Sabouraud's maltose agar. The *optimum* temperature is between 30° and 40° Celsius.

The composition of Sabouraud's medium is :

Maltose	4 grammes.
Peptone (Chassaing)	1 gramme.
Agar	1·5 grammes.
Distilled water	100 c.c.

Culturally, the fungi may be divided in five groups :

1. Those showing in cultures aspergillar fructifications.
2. Those showing penicillium fructifications.
3. Those showing intermediate fructifications between the *Aspergillus* and the *Penicillium*.
4. Those showing simpler fructifications characteristic of the genus *Monilia*—viz., a mycelial thread terminating in a single string or small bunch of roundish spores.
5. Those in which higher organs of reproduction are absent, and reproduction takes place somewhat similarly to what is observed in the genera *Microsporon* and *Trichophyton*—by conidia and terminal segmented and unsegmented 'spindles.' The fungi of this group found by Montoya in a variety of black pinta, by Bodin, and later by Castellani, in a variety of red pinta, constitute the genus *Montoyella*.

Inoculation Experiments.—Montoya has tried to infect rabbits, using various cultures of the fungi found in the disease. On several occasions a desquamation of skin and loss of hair was observed, and some chromatic patches appeared. Uribe succeeded in inoculating several mulattoes.

According to Montoya, the fungi of pinta live saprophytically in certain waters, especially in those of mines and localities where the temperature is constantly high. He states that he obtained pure cultures of the pinta fungi direct from such waters. He has also found the same fungi as ectoparasites on the bodies of mosquitoes of the genus *Culex*, on sandflies (*Simulium*), and on the body of some bugs (*Cimex*) which are very common in the mines. He believes, therefore, that mosquitoes and other insects play a rôle in the transmission of the disease.

In some old chronic cases of pinta an *Acarus*—somewhat resembling *Acarus scabiei*, though larger—has been found to live in the epidermal squamæ, and some writers believe that this *Acarus* also plays a part in the transmission of the malady.

Predisposing Causes.—What the older authors believed to be the true causes of pinta—viz., a hot, damp climate ; insanitary surroundings and poor feeding ; the mineral salts contained in the waters—are only predisposing causes, some of which, however, are of great importance. The hot, damp climate favours the growth of the fungi ; the water of the mines, which contains a large

amount of mineral salts (especially sulphates), produces after a time in those who use it for washing, etc., a dermatitis with fissures and other eczematous-like lesions which greatly facilitate the infection.

All races are liable to be attacked by the disease, but mulattoes seem to be particularly prone to become infected. Albinos are said to be immune. Both sexes are equally liable to become infected, though males, on account of their occupations, are more frequently affected. The malady generally appears between the age of fifteen and twenty-five, but it may appear at any age, and has been seen in children three or four years old.

It has been observed that individuals of the negro race are more liable to contract the black variety than any other kind of the disease, while whites are especially liable to contract the red variety. Miners and agricultural labourers are affected in most cases by the violet variety.

Symptomatology.—The disease begins very gradually. After an incubation period, varying, according to different authors, between a few weeks and some months, one or several small slightly pruriginous spots appear on uncovered parts of the body. The spots increase very slowly in size, and some may fuse together. They are roundish, or may have an irregular outline. At first they are hardly raised above the normal skin. The surface of the patches is generally dry and rough, and is covered with fine pityriasic squamæ in recent cases, with larger and thicker scales in older ones. Occasionally, in chronic cases, the surface of the patches, instead of being dry, may be moist or somewhat greasy or glutinous.

The hairs of the affected regions become atrophied, and later on fall out. The shedding of hair is not due to the fungi invading directly the hair ; it is due to a peculiar fibrosis of the hair-follicle, at the place of the hair a hard formation remaining, like a grain of sand (fibroid folliculitis of Montoya).

Pruritus is generally well marked, especially at night-time. There are often patches of hyperkeratosis in the palms and soles, and the normal lines and sulci appear much deeper.

Old chronic cases occasionally exhale a peculiar musty odour, which has been compared to the smell of cat's urine, or to the bad smell of dirty linen kept in a warm, damp place.

The affection may spread to the whole body, except the palms of the hands and the soles of the feet. The nails are never attacked. The scalp is not usually affected.

The disease has no tendency to spontaneous cure. Its course is very chronic, and may last the whole of the patient's life.

Some of the older authors state that the patients during the incubation period suffer from fever, vomiting, and diarrhœa. Montoya says that pinta patients have not got an odour *sui generis*, as stated by most observers. In cleanly patients no smell whatever is felt, apart from the peculiar odour of the negro race.

Clinical Varieties.—Clinically, six different varieties may be distinguished, each of which shows several subvarieties :

1. The Black Variety.
2. The Blue Variety.
3. The Violet Variety.
4. The Red Variety.
5. The Yellow Variety.
6. The White Variety.

Black Variety.—The patches are of a black colour, and are very often found on the face, though they may be present on any other part of the body, except the palms and soles, similarly to all the other varieties. The patches are hardly raised, and their surface is slightly desquamating. Pruritus is generally complained of, but is not, as a rule, so unbearable as in the other varieties. Black pinta is found in negroes more frequently than in individuals of Caucasian race. The course is very chronic. The treatment is difficult, though not so difficult as in the other varieties.

Black pinta shows two subvarieties—one is characterized by the presence of patches of a black-violet colour ; the other by patches of jet-black, indian-ink black colour. The fungus found in the first is an *Aspergillus* (species undetermined) ; in the second a *Montoyella* (*M. nigra*).

Blue Variety.—This is much less frequent than black pinta. The patches are of a blue colour. They generally begin to appear first on the dorsum of the hands, and then tend to spread over the whole body—uncovered as well as covered parts. There generally is intense pruritus.

The fungus usually found in blue pinta is *Aspergillus.*

Violet Variety.—Apart from the colour of the patches, which is violet, the clinical symptoms and course of this variety are identical with those of blue pinta. It is extremely common among rural labourers and miners.

There are numerous subvarieties of violet pinta. In some cases the patches are of a pure violet colour ; in other cases the colour may be violet-greyish, violet-brownish, violet-purplish. There are cases in which the patches are at first of a greenish colour, to become violet-bluish later on. The fungus found in the pure violet pinta is an *Aspergillus* (*A. pictor* Blanchard 1895) ; the fungus found in the violet-greyish cases is a *Penicillium—P. montoyai* (Castellani) 1907 ; the fungi found in the other varieties are *Aspergilli* or fungi presenting transition characters between the *Aspergillus* and the *Penicillium.*

Red Variety.—This is the commonest variety found in white patients. The patches first develop, as a rule, on the dorsum of the hands and feet, and spread to large portions of the body. The patches are red—often brick-red—and usually show a rather abundant desquamation. Pruritus is very distressing, especially at night-time. Secondary lesions due to scratchings and inocula-

tion of pyogenic micro-organisms are not rare. Ulcerative lesions have been reported by several observers as occasionally occurring.

In some cases of red pinta an *Aspergillus* (species not determined) is found; in others a fungus of the genus *Montoyella M. bodini* (Castellani) 1907, found by Bodin in 1903 in a patient who was under the treatment of Darier.

Castellani, in 1907, found the same or a very similar *Montoyella* in a case of red pinta observed in a European sailor who had long been in tropical America. In this case the disease had not yet spread much. Besides the red patches, there was on the right forearm a small greyish-violet spot, in which a fungus was found, which gave *Penicillium* fructifications in cultures (*P. montoyai*).

Red pinta is more serious than any other variety, as it affects not only the superficial strata of the epidermis, but the rete Malpighii as well as the corium.

Yellow Variety.—Very common among half-castes. It generally begins on the chest or arms. The patches are yellow, and at first are not pruriginous and not desquamating. In old cases, however, there is pruritus. This variety is very frequently mixed with patches of white pinta, and is difficult to cure. The fungi found belong to the genera *Monilia* and *Aspergillus*.

White Variety.—The patches are of a dull white colour, and are generally very large. The surface is usually rough and desquamating, but at times it may be smooth. In some cases a fungus of the genus *Monilia* is present, but, according to Montoya, in other cases no fungus whatever is to be found. Montoya considers the white variety of pinta to represent in many cases the ultimate retrogressive stage of all the other varieties except the red. The patches of white pinta would be in such cases in reality unpigmented, leucoderma-like areas due to the disturbing action of the various fungi on the pigmentation processes of the skin.

Montoya's belief on the nature of white pinta in some cases is supported by Castellani's observations on tinea flava and tinea alba. In both these dermatomycoses white, pseudo-leucodermic patches may occasionally be seen long after the fungus had died out, and these patches may remain unpigmented for months and years.

Mixed Variety.—Not infrequently the same patient may be affected with several varieties of pinta, presenting a grotesque tattooed or piebald appearance.

It is especially white pinta which is found associated with one or more of the other varieties.

Diagnosis.—This does not present any difficulty in the countries where the disease is endemic. In any doubtful case the microscopical examination, supplemented when necessary by the use of cultural methods, will clear the diagnosis.

Differential Diagnosis: Tinea nigra.—In contrast to the black variety of pinta, tinea nigra is very superficial, does not extend to large portions of the body, may attack the palms of the hands, is not pruriginous, is easily cured except when affecting the palms.

The microscopical examination of scrapings from patches of tinea nigra will show mycelial tubes of irregular shape and large globular spores collected in bunches. The spores are grouped together in a somewhat similar manner to what one sees in pityriasis versicolor.

Tinea flava.—In contrast to yellow pinta, the fungus of tinea flava is a Malassezia, has the same morphological characters of the fungus found in pityriasis versicolor, and cannot be grown artificially.

Tinea albigena and Tinea alba.—These are trichophytic affections, and are easily distinguished by the characters of the fungi.

Leprosy can be distinguished from white pinta lesions by the sensibility not being impaired in Pinta.

Only white pinta patches with no fungus might be mistaken for *leucoderma* on superficial examination. White pinta is very often associated with other varieties of pinta, which are easily diagnosed. Leucodermic patches are smooth, non-pruriginous, and the skin surrounding them is often hyperpigmented.

Prognosis.—Pinta, though not a fatal disease, must be considered a serious affection, as its course is chronic, and the treatment very difficult. In most cases the general health remains satisfactory, but the disfigurement is very distressing to the patients, who often become nervous and irritable. The pruritus, which is generally more marked at night, is also a cause of great distress and sleeplessness.

Treatment.—The popular treatment in Columbia is citrine ointment (mercury nitrate ointment). Other parasiticides have been tried, with a varying degree of success. When the eruption is at the very beginning, tincture of iodine may suffice. The best results have been obtained by using chrysarobin (chrysarobin, gr. x. to xxx.; ung. zinci ox., ℥i.). This must be applied cautiously. When the malady affects large tracts of the body, only a portion should be treated at a time, to prevent as far as possible symptoms of absorption. The urine should be regularly analyzed during the treatment. The chrysarobin ointment must not be applied to the face, lest a severe conjunctivitis should develop. For the face a resorcin, or resorcin-sulphur, or resorcin-salicylic, or salicylic acid ointment (resorcini, gr. xxx. to ℥i.; ac. salicylici, gr. xv.; vaseline, ℥i.), is advisable, or citrine ointment may be used.

Montoya recommends chrysarobin dissolved in chloroform (chrysarobin 10 parts, chloroform 90 parts). Apply with a fine brush. When dry, apply gutta-percha dissolved in chloroform (gutta-percha 10 parts, chloroform 90 parts).

Chrysarobin may conveniently be applied in the form of a vernisol varnish (5 to 10 per cent.).

PIEDRA.

Synonym.—Trichosporosis tropica.

Definition.—Piedra is a mycotic disease of some parts of South America causing small nodosities on the hair.

Remarks.—This disease of the hair is found in some districts of Columbia, especially the valleys of Canca ; but closely allied conditions are observed in several parts of the tropics, and occasionally in temperate zones (*piedra nostras*).

Ætiology.—If an affected hair is washed in ether, and then treated with liquor potassæ, and examined microscopically, the nodules will be seen to consist of large polyhedric refringent bodies, held together by an amorphous substance acting as cement. These bodies are the spores of the fungus causing the disease (*Trichosporum giganteum* Behrend 1890). In Columbia it is generally believed that the infection takes place by washing the hair with a mucilaginous oil, much used by the women of the country.

Symptomatology.—The hair of the head of women, and less frequently the hair of the head and beard of men, is affected. The affected hairs present strings of pin-head-sized nodosities, which are better felt than seen. The nodosities may be very numerous, and are found on the surface of the hair-shaft, either on one side or surrounding it like a sheath. They are black and hard, though not so hard as the name piedra (stone) would imply, and a kind of crepitation is produced when the hair is combed. There is often matting and knotting of the hair. The disease is chronic, and the nodosities do not disappear spontaneously.

Diagnosis.—The microscopical examination of the nodosities renders the diagnosis easy.

Prognosis.—The affection is of long duration, and has no tendency to spontaneous cure.

Treatment.—This is difficult. It has been recommended to apply benzene and turpentine to the hair, and to wash the head regularly with a perchloride lotion (1 in 2,000). In obstinate cases it is necessary to shave the head.

Trichosporosis Indica.

In India and Ceylon a condition similar to piedra is occasionally observed. It is, however, much less severe, a few minute nodules only being present on the hairs of the beard and moustache, and the hair of the scalp being rarely affected The fungus seems to be different from that of the Columbian piedra.

Trichomycosis Nodosa Tropica.

This is common in Ceylon, and affects the hair of the scrotum and axillæ. The affected hairs present one or several hard, small nodules, which on microscopical examination show a prodigious number of rod-like organisms, easily stained with fuchsin. Cultures so far have failed.

Trichosporosis of Temperate Zones.

Cases of trichosporosis of temperate zones, or piedra nostras (tinea nodosa), have been described by Beigel (1869), Caro, Behrend, Unna, Pick, Villemin. The nodosities in such cases have been found on the hairs of the moustache and beard, not on the hairs of the head. The fungi are slightly different from *T. giganteum*. Several species have been described—*T. beigeli* Rabenhorst 1867, *T. ovoides* Behrend 1890, *T. ovale* Unna 1896.

Trichomycosis Nodosa of Temperate Zones.

Synonym.—Leptothrix ; *T. palmellina* Pick.

This is found in temperate zones. The hairs of the axillæ and scrotum are brittle, and show numerous hard formations or concretions along the shaft. These concretions are resistant to strong alkalis, acids, chloroform, ether, benzine. Cocci and bacilli have been described by several authors.

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CHAPTER LVI

SKIN DISEASES (*continued*)—DERMATOZOIASES

General remarks—Creeping eruption—Circinate creeping disease—Cutaneous and subcutaneous myiasis—Dermatophiliasis.

Remarks.—Dermatoziasis in the wider sense of the word means any skin disease of animal origin, but the term is generally restricted to those dermatoses caused by animal parasites higher than protozoa. These skin diseases may be classified into the following groups:

I. *Due to Platyhelminthes—e.g.:*
Sparganum proliferum.

II. *Due to Nemathelminthes—e.g.:*
Filaria medinensis.
Agchylostoma duodenale.
Necator americanus.

III. *Due to Arachnida—e.g.:*
Sarcoptes scabiei.
Rhizoglyphus parasiticus.
Demodex folliculorum.

IV. *Due to Hexapoda—e.g.:*
Larvæ of various flies.
Dermatophilus penetrans.

Most of the dermatozoiases have been mentioned in connection with the parasites which cause them (Chapter XX.), while others, such as scabies, cannot be considered as strictly tropical diseases, and hence cannot be dealt with here. It only remains to draw attention to the creeping eruptions, cutaneous myiasis, and dermatophiliasis.

CREEPING ERUPTION.

Synonym.—Larva Migrans.

This disease was first described by A. Lee in 1875. Later on, Procke, Blanchard, Topsent, Fülleborn, and others have recorded several cases. It is not rare in some parts of Europe, Africa, and Asia, and in South America. It is extremely rare in North America.

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MANUAL

OF

TROPICAL MEDICINE

BY

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PREFACE TO THE SECOND EDITION

THE first edition of this manual having been exhausted, we have revised most of the chapters, and have added to the letterpress and somewhat extensively to the illustrations.

As far as possible we have endeavoured to benefit by the kind criticisms which we have received, as some of the new chapters will indicate, but we are painfully aware of the great possibilities of error, clerical and otherwise, in a work of this nature, and we crave the kind indulgence of the reader for such as may be found.

We desire to record our grateful appreciation of the kind help received from Colonel Sir William Leishman, Sir Ronald Ross, Dr. Leiper, Dr. G. C. Low, Dr. Sambon, Mr. Austen, Professor Splendore, Professor Nuttall, Mr. Cantlie, Dr. Ernest Black, Dr. Keating, Dr. Chagas, Dr. Vianna, Dr. Fantham, Professor Stephens, Dr. Bulloch, Dr. E. H. Ross, Mr. Wellcome, Professor Mesnil, Professor Pinoy, Professor Brumpt, Professor Newstead, Professor Terni, Dr. Seligmann, Professor Pittaluga, Dr. MacLeod, Professor C. J. Martin, Dr. Cranston Low, Dr. Bell, Dr. Child, Dr. Basile, Mr. Burgess, Dr. Nell, and Dr. Distaso.

We also desire to express our indebtedness to the authorities of the Royal Society, the India Office, the *British Medical Journal*, the *Lancet*, the *Centralblatt für Bakteriologie*; to Messrs. Hutchinson and Co., Messrs. Bale, Sons, and Danielsson, and Messrs. Cassell and Co., for kind permission to copy some of their illustrations.

It gives us much pleasure to thank our talented artist, Mr. Terzi, for the able manner in which he has executed the new illustrations. We also acknowledge with much appreciation the skill with which Mr. M. J. de Silva has executed the photographs of the skin diseases.

We again offer our publishers, Messrs. Baillière, Tindall, and Cox, our thanks for their continued kindness and courtesy.

ALDO CASTELLANI.
ALBERT J. CHALMERS.

LONDON,
March, 1913.

PREFACE TO THE FIRST EDITION

THIS book is an attempt to describe the knowledge which we have found necessary to acquire and use during our work in Tropical Africa and Asia. We are well aware how difficult it is to discover one's own omissions and mistakes, and for such as may be found in this work we ask the indulgence of the reader.

An attempt has been made to keep the book as small as possible, but at the same time to describe, however briefly, the many subjects with which we have found it necessary to be acquainted. In order to attain this object, we have omitted all reference to practical laboratory methods, as such can readily be obtained in the excellent works of Daniels and Staunton, or Stephens and Christophers. Similarly, detailed descriptions of bacteria have not been included, as they are contained in any of the modern textbooks on bacteriology, such as those by Muir and Ritchie, by Hewlett, or by Stitt, one of which should be in the possession of every practitioner working in the Tropics. Notwithstanding our desire for brevity, we have considered it advisable in a few instances to repeat our descriptions of parasites in the clinical portion of the work. This, however, has only been done when such descriptions were necessary, in order to give the reader a clear general account of the disease.

In the Clinical Section we have given importance to the descriptions of treatment, going into details, which some may think superfluous; but we know by experience that these details as regards dosage, modes of administration, etc., are required by the practitioner working in the Tropics, who often has no opportunity of consulting books on therapeutics and materia medica.

We desire to acknowledge gratefully the sympathy shown to us by the officials of the Colonial Office in London during the preparation of this work.

We are indebted to Sir Hugh Clifford, K.C.M.G., Sir Allan Perry, M.D., Dr. Sambon, Dr. Willey, Mr. Green, Miss Robertson, Mr. Barnard, Mr. Browning, and Mr. Drieberg, for reading certain portions of the proofs, and for kindly lending us specimens and illustrations.

It gives us great pleasure to express our thanks to our artists, Mr. Terzi and Mr. M. J. de Silva, for the skill with which they have executed the drawings. Though a large number of these are original, still we have been compelled in order to illustrate the work fully to draw upon the generosity of a number of authors and publishers. We desire to state how much we are indebted to the kindness of these gentlemen in allowing us to redraw their originals —a task which has been performed as carefully as possible, and it is hoped that no error has in any way crept in.

It is our desire to acknowledge in the fullest manner the source of these copied drawings, and if any omission is found it is purely accidental. We are especially indebted to Professor Looss, of Cairo, who with the greatest generosity offered us his valuable original drawings of worms ; to Professor Nuttall, many of whose drawings of mosquitoes and ticks have been used ; to Mr. Austen and the Trustees of the British Museum for several illustrations of mosquitoes and flies ; to Professor Ross for permission to copy certain drawings from the publications of the Liverpool School of Tropical Medicine ; and to Professor R. Blanchard, Professor Hartmann, Professor Fülleborn, the Honourable Charles Rothschild, Dr. Lesage, Dr. Rodewald, and Dr. Neveu-Lemaire, for permission to use some of their valuable drawings.

We have also to thank Colonel Sir William Leishman, the Honourable Mr. Warren, C.M.G. (Surveyor-General of Ceylon), Professor Grassi, Dr. C. Mense, Colonel Giles, Captain Christophers, Captain Craig, Captain Patton, Mr. Fantham, and Mr. Dobell, for kind permission to utilize their illustrations.

We have also to acknowledge the kindness of the authorities of the Royal Society, and of the Hygiene Laboratory of the Public Health and Marine Hospital Service of the United States, as well as the Editors of the *Archiv für Schiffs- und Tropen-Hygiene*, of the *Lancet*, of the *British Medical Journal*, of the *Archiv für Protistenkunde*, of the *Quarterly Journal of Microscopical Science*, of the *American Journal of Medical Sciences*, of the *Journal of Hygiene*, and of the *Journal of Parasitology*, in allowing us to copy certain prints.

Finally, we desire to acknowledge the constant kindness and courtesy of our publishers, Messrs. Baillière, Tindall, and Cox.

ALDO CASTELLANI.
ALBERT J. CHALMERS.

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CHAPTER XXVII

VEGETAL PARASITES: FUNGI

Thallophyta—Algæ—Fungi—Phycomycetes—Ascomycetes — Basidiomycetes —References.

THE vegetal kingdom is usually divided into the following four chief groups:

I. Thallophyta, a great variety of plants whose vegetative body may consist of one or many cells forming a more or less branched thallus.

II. Muscineæ, or Bryophyta, including cormophytic forms as well as forms with a leaf-like thallus.

III. Pteridophyta, or fern-plants.

IV. Phanerogams, or flowering-plants.

THALLOPHYTA.

All vegetal parasites of man belong to the Thallophyta, which consist of two classes:

CLASS A. THE ALGÆ.—These possess chromatophores, while many species are provided with chlorophyl.

CLASS B. THE FUNGI.—These possess neither chromatophores nor chlorophyl.

CLASS A. THE ALGÆ.

The Algæ contain four orders:

I. Cyanophyceæ.
II. Chlorophyceæ.
III. Pheophyceæ.
IV. Florideæ.

Only the order Cyanophyceæ has importance from the point of view of human parasitology. This order contains two families:

I. Nostocaceæ, organisms containing chlorophyl.
II. Bacteriaceæ, organisms not containing chlorophyl.

The family Bacteriaceæ is very important, containing most of the pathogenic micro-organisms of man. As, however, the study

of bacteria forms a special branch of science, on which numerous works and textbooks are available, we shall not deal with it, limiting ourselves to the description of the non-bacterial fungi.

CLASS B. THE FUNGI.

Fungi play a very important rôle in human, animal, and vegetal pathology; they also play an important part in some biological processes—for instance, *fermentation*.

The study of fungi is called 'mycology,' and a disease due to a fungus is termed a 'mycosis.' Thus 'otomycosis' means a mycosis of the ear; 'onychomycosis,' a mycosis of the nails; 'dermatomycosis,' a skin disease due to fungi.

The investigation of fungi began long before that of *bacteria*. In 1837 Remak discovered the parasite of *favus*, which was more completely described by Schönlein in 1839. Between 1841 and 1844 Grüber described the fungi found in thrush and ringworm.

Morphology.—Fungi are Thallophytes without chlorophyl, and do not contain starch or chromatophores. Their vegetative body, or thallus, consists generally of a mass of filaments or threads termed the 'mycelium.' The threads or filaments forming the mycelium are called 'hyphæ.' The mycelial threads or hyphæ may be *septate* or *non-septate*. Their walls do not consist of ordinary cellulose, but of a substance known as *fungus-cellulose*, which does not stain blue by iodine and sulphuric acid.

Nutrition.—The fungi, being unprovided with chlorophyl, cannot make use of the carbon dioxide of the air, and therefore derive their carbonaceous food material from complex organic compounds, as, for instance, decaying organic substances.

Mode of Life.—Fungi live as parasites or as saprophytes. They may live one way or the other, according to circumstances. Fungi are parasites of man, of the lower animals, and of plants.

Biological Characters.—Recent researches have shown the great biological analogies between fungi and bacteria as regards production of toxins, agglutination, and immunization phenomena, etc. Charrin and Ostrowsky, Concetti, Roger, and others, have obtained a soluble toxin from *Monilia albicans*. Auclair and Verliac have isolated from *Nocardia bovis* a toxic product soluble in ether, which they call 'actinomycetine.' They state that the injection of this substance produces the same lesions as the fungus. Ceni, Besta, Otto, and others, have obtained various toxins from fungi of the genus *Aspergillus*.

Concetti and G. H. Roger, by vaccinating animals with cultures of *Monilia candidans*, have noticed a production of specific agglutinins and immune bodies.

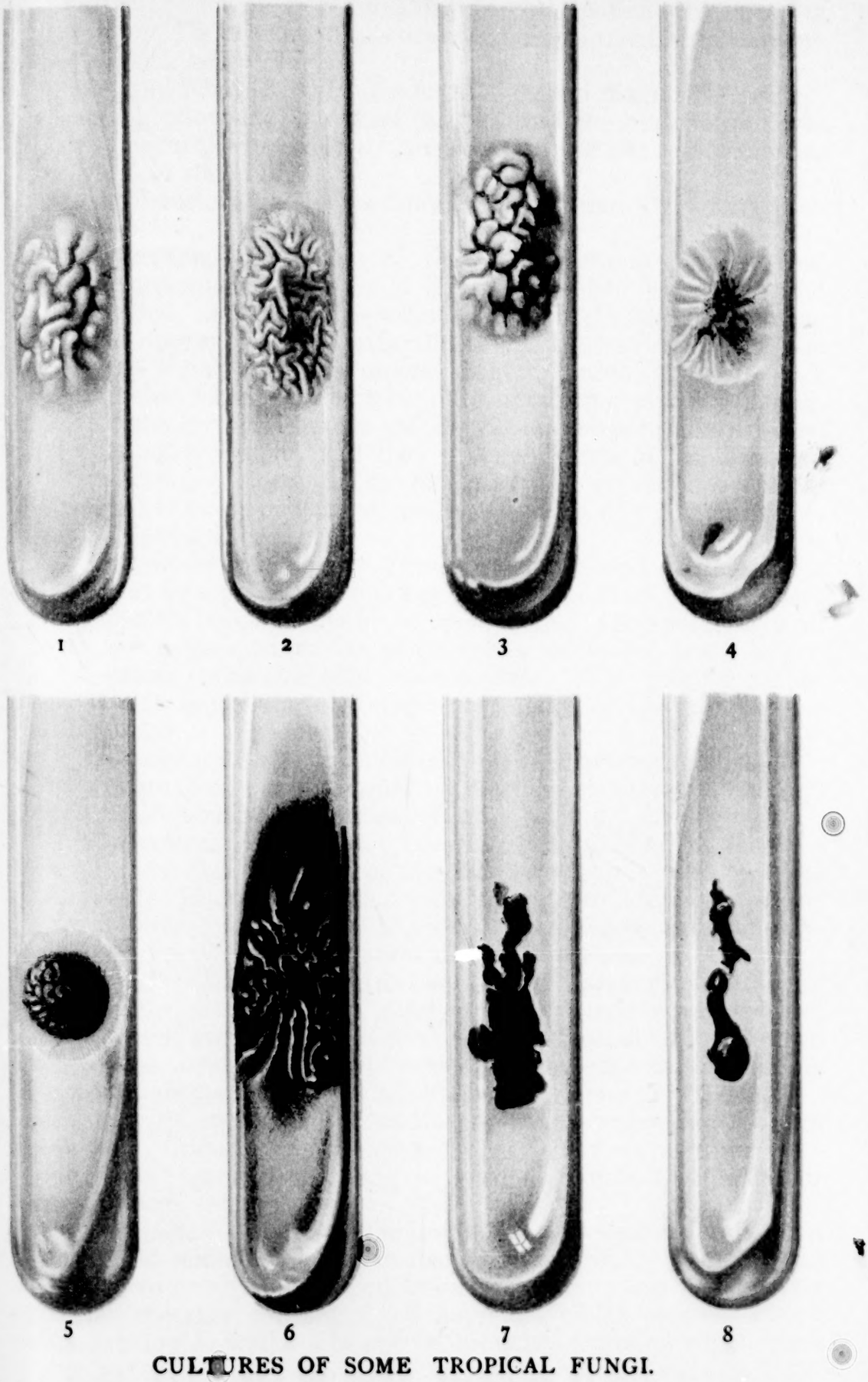
Plato, Bloch, Truffi, and others have prepared trichophyton vaccines by killing with heat, and triturating cultures of these fungi. By injecting these vaccines into patients suffering from trichophytoses, they have observed a general reaction, with fever,

PLATE V.

CULTURES OF SOME TROPICAL FUNGI.

1. ENDODERMOPHYTON CONCENTRICUM BLANCHARD 1901.
   Typical culture on glucose agar three weeks old.
2. ENDODERMOPHYTON CONCENTRICUM BLANCHARD 1901.
   Old culture on glucose agar.
3. ENDODERMOPHYTON INDICUM CASTELLANI 1911.
   Fairly old culture on glucose agar.
4. ENDODERMOPHYTON INDICUM CASTELLANI 1911.
   Young culture on glucose agar.
5. EPIDERMOPHYTON RUBRUM CASTELLANI 1909.
   Culture on glucose agar.
6. TRICHOPHYTON VIOLACEUM BODIN 1902; VAR. DECALVANS CASTELLANI 1911.
   Culture on Sabouraud's agar.
7. CLADOSPORIUM MANSONI CASTELLANI 1905.
   Culture on Sabouraud's agar.
8. MICROCOCCUS NIGRESCENS CASTELLANI 1910.
   Culture on Sabouraud's agar.

PLATE V.



CULTURES OF SOME TROPICAL FUNGI.

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To face page 758

similar to the reaction obtained in tubercular patients by injecting tuberculin. De Beurmann has described a cuti-reaction in patients affected with sporotrichosis.

Widal and Abrami have introduced a general diagnostic method, 'sporo-agglutination,' based on the fact that the blood of patients suffering from diseases due to fungi contain specific agglutinins for the spores of such fungi.

Other biological reactions—complement fixation, etc.—have been described.

Reproduction.—The seeds of the Phanerogamia may be said to be represented in the fungi by the roundish or oval-shaped bodies called 'spores.' The spores multiply by budding, producing daughter spores, identical with the parent spores. Under certain conditions the spore, by a process of germination, gives rise to a true mycelial filament, which ramifies, producing mycelial hyphæ. Some of the terminal hyphæ are shorter and structurally different from the other hyphæ, and they become organs of fructification, which produce spores. The formation of spores upon these hyphæ takes place in various modes, of which five different types may be distinguished.

1. *Conidia or Exospores.*—These are non-sexual spores, which take origin by a process of budding or septation from the extremity of a germinal mycelial hypha or *sporophora*. The spores may all be of the same size, or, at other times, some are much larger, *macroconidia*, others smaller, *microconidia*. The conidia are at first always unicellular, but later they may divide and become multicellular.

2. *Chlamydospores or Endoconidia.*—These are asexual globular spores of great size, and provided with a thick membrane. Chlamydospores are terminal or intramycelial.

3. *Endospores or Conidia.*—These spores take origin inside a special spore-case structure, or *sporangium*, which is often terminal and aerial. Endospores which are free and provided with organs of locomotion (cilia or flagella) are called *zoospores*, and the sporangium is known under the name of *zoosporangium*.

Ascus Fructifications, or *Asci*, are special sporangia, containing four or eight or a multiple of eight spores arranged in a single line. These spores are called *ascospores*. Each ascospore presents two membranes, *one internal, one external*. The external membrane frequently shows a pore, which is called the *germinating pore*.

Basidia Fructifications.—Basidia are large elongated cells, each of which supports at its apex two or four slender processes (sterigmata), each terminating in a small roundish conidium or basidio-spore.

4. *Zygospores.*—These are the product of a process of conjugation or modified sexual act between two special hyphæ. These hyphæ give rise to small club-shaped branches, which come into contact and fuse together, forming a new large cell, which presents a very resistant double wall. The special branches (*gametes*) which come

into contact and unite to produce the *zygospore* do not show any apparent sexual differentiation.

5. *Oospores.*—These are formed by a complete sexual act or fertilization, and can therefore be compared with a fertilized ovum.

The female element (*oosporangium, oogonium*) contains one or more roundish protoplasmatic masses (macrogametes or *oospheres, female gametes*), and presents a thick wall pierced by several *pores.* The male gamete (*antheridium*), which originates on a delicate special hypha, comes into contact with the oosporangium, sending a protoplasmatic process through it. In other cases the *antheridium* divides into several motile bodies called *microgametes, antherozoids,* or *spermatozoids,* which come into contact with the oosporangium, and fertilization takes place. In some rare cases the transformation of the oosporangium into an oospore is in reality a process of parthenogenesis.

Classification.—Fungi are divided into five orders :

I. Myxomycetes.—Higher fungi, mostly aerial, with many-celled mycelium ; reproduction by asexual spores.

II. Phycomycetes.—One-celled thallus, becoming septate only during sporulation ; reproduction takes place by asexual and sexual spores.

III. Ascomycetes.—Reproduction by asexual spores ; presence of *ascus fructifications.*

IV. Basidiomycetes.—Reproduction by asexual spores ; presence of *basidia fructifications.*

V. Hyphomycetes, or Fungi Imperfecti.—Fungi of very different groups, the botanical position of which cannot be determined with certainty in the present state of our knowledge. The thallus consists of filaments, and reproduction takes place only by conidia.

The fungi parasitic in man are practically all found among the Phycomycetes, the Ascomycetes, and the Hyphomycetes. Only one species of importance is found among the Basidiomycetes, and none among the Myxomycetes.

ORDER PHYCOMYCETES.

This order is divided into three suborders :

I. Chytridiæ.
II. Oomycetes (Oosporaceæ).
III. Zygomycetes or Zygosporaceæ.

The Phycomycetes parasitic on man all belong to the suborder Zygomycetes.

SUBORDER ZYGOMYCETES.

These fungi reproduce sexually and asexually. The sexual reproduction takes place by formation of *zygospores.* The asexual reproduction takes place by the formation of conidia, gonidia (endospores), and chlamydospores (endoconidia).

The Zygomycetes are divided into four families, among only one of which—the Mucoraceæ—are found human parasites.

Family Mucoraceæ.

These organisms have a ramified thallus, branches taking origin laterally or by dichotomy. Some species are provided with *rhizoids*, root-like hairs by which they are attached to the surface on which they grow. From the surface of the mycelium some aerial branches called 'gonidiophores' take origin, each of which supports on its distal extremity a pear-shaped, globular or claviform sporangium called *gonidangium*. The *sporangium* is at first separated from the gonidiophore by a septum, which later protrudes into the lower portion of the sporangium to form a variously shaped structure termed the *columella*.

Inside the sporangium or gonidangium *endospores* or *gonidia* develop by free cell-formation.

The sporangial protoplasm not used in the formation of endospores gives rise to a peculiar mucilaginous substance, which at a later period, by absorption of water, causes the bursting of the sporangium. Each endospore or gonidium, when it has become free, gives rise to a mycelial tube by germination. This mycelial tube ramifies, and a new mycelium is formed.

In some species, under certain conditions, a sexual reproduction may take place. This consists in the conjugation of undifferentiated non-motile gametes, which leads to the formation of zygospores.

Many species, when vegetating in unfavourable media, reproduce only by formation of conidia and chlamydospores.

The Mucoraceæ are extremely common as parasites or saprophytes of plants and animals. A mycosis due to these parasites is often termed 'mucormycosis.'

Mucoraceæ can be easily grown on sugar culture media—for instance, Sabouraud's maltose agar—or even on ordinary agar. The optimum temperature for their growth is between 35° and 40° C. The Mucoraceæ require plenty of oxygen, and therefore the media tubes must never be closed with rubber caps. When there is not enough oxygen, the Mucoraceæ lose their characteristics, and give rise to monilia-like, or yeast-like forms.

Classification.—Four genera of Mucoraceæ are found to contain species parasitic on man:

Family Mucoraceæ
- Mycelium ramified, no rhizoids—*Mucor*.
- Mycelium non-ramified, with or without rhizoids; the peduncle supporting the sporangium terminates in a special formation encircling the base of the columella—*Lichtheimia*.
- Mycelium with rhizoids; columella ovoid—*Rhizomucor*.
- Mycelium with rhizoids; columella hemispherical, shaped like a mushroom—*Rhizopus*.

Genus Mucor Micheli 1729.

Ramified mycelium; absence of rhizoids

Mucor mucedo Linnæus 1764.

Synonyms.—*Mucor vulgaris* Micheli 1729, *M. sphærocephalus* Bulliard 1791.

The hyphæ carrying sporangia (sporangiophores) are long and erect; the sporangium is globular, 100 to 200 μ in diameter; its colour brownish; its surface covered by fine, minute crystals of

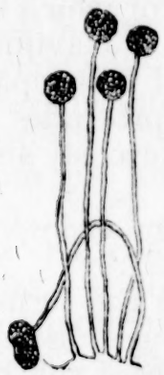

FIG. 365.—MUCOR MUCEDO LINNÆUS.

FIG. 366.—MUCOR PUSILLUS LINDT. (After Lindt.)

oxalate of calcium. The spores (gonidia) are elliptical, with a smooth surface. The columella is ovoid-shaped, and generally yellowish. Occasionally very large zygosphores may be observed.

M. mucedo L. is very common, living in organic substances in decomposition—for instance, horse-dung. It is the cause of a deadly disease in bees—the so-called 'mucorine,' or May's disease—but is seldom found in man. Fürbringer has observed it twice in cases of pulmonary infarcts.

Mucor pusillus Lindt 1886.

Mycelium at first white, then yellowish. The hyphæ carrying sporangia are much shorter than in the preceding species. The sporangium is globular, at first pale greyish, then dark greyish. Its diameter varies between 50 and 80 μ. The columella is claviform, ovoid or spherical, yellowish or brownish. The spores are smooth, spherical, 3 to 3·5 μ in diameter.

M. pusillus is often found in bread which has been soaked in water. It is very pathogenic to rabbits; it has once been found in man in a case of otomycosis by Jakowski.

Genus Lichtheimia Vuillemin 1904.

Non-ramified mycelium; rhizoids may be present or not; peduncle supporting sporangium terminates in a formation encircling the base of the columella.

Lichtheimia corymbifera Cohn 1884.

Synonym.—*Mucor corymbifer* Cohn 1884.

Mycelium at first white, then yellowish. The sporangia are pear-shaped, 10 to 70 μ in diameter ; columella conical, dark greyish or brownish ; spores elliptical, 2 to 3 μ. The hyphæ carrying sporangia are ramified in corymbiform formation. This parasite has been

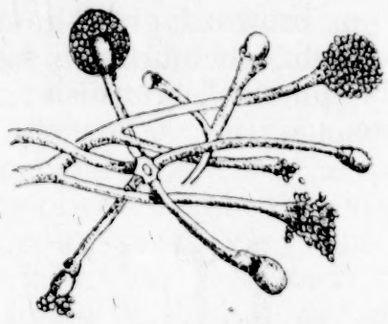

FIG. 367.—LICHTHEIMIA CORYMBIFERA VUILLEMIN.
(After Lichtheim.)

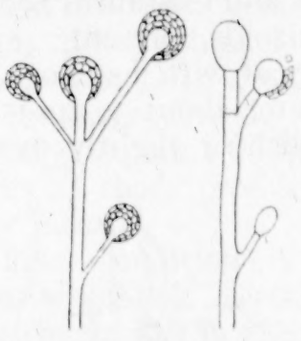

FIG. 368.—RHIZOMUCOR PARASITICUS LUCET AND COSTANTIN.
(After Lucet and Costantin).

observed several times in man, giving rise to a mycosis of the ear (Hückel, Siebenmann, Graham), of the nose (Siebenmann), of the lungs (Podack). A case of generalized infection has been recorded by Paltauf (see p. 765).

Lichtheimia ramosa Lindt 1886.

Synonyms.—*Mucor ramosus* Lindt 1886, *Lichtheimia ramosa* Vuillemin 1904.

Closely resembles *L. corymbifera*, but rhizoids are often present. The spores are larger, ovoidal, 4 to 7 μ in length. The columella is always smooth.

This species has been observed in man by Jakowski in a case of otomycosis. According to Vuillemin, it is frequently found in the nasal mucosa of horses.

Genus Rhizomucor Lucet and Costantin 1900.

Rhizoids generally present, columella of ovoid shape.

Rhizomucor parasiticus Lucet and Costantin 1900.

Mycelium at first greyish, later brownish. Sporangium globular, 35 to 80 μ. Hyphæ carrying sporangia are often ramified, and are between 1 and 2 centimetres in length. They are often provided at their basal portion with rhizoids.

The columella is ovoid or pyriform ; dark brownish ; spores ovoid ; longitudinal diameter, 4 μ ; transverse diameter, 2·5 μ.

R. parasiticus is pathogenic for guinea-pigs and rabbits. It was found in the expectoration of a woman by Lucet, Costantin, and

Lambry. The patient had been considered at first to be suffering from tuberculosis. She recovered under a potassium iodide and arsenical treatment.

Rhizomucor septatus von Bezold 1889.

Synonyms.—*Mucor septatus* von Bezold, *Rhizomucor septatus* Lucet and Costantin 1889.

Rhizoids present; sporangia of a brownish-greyish colour, spherical, with a smooth, or occasionally slightly moriform, surface; diameter about 30 to 35 μ; columella spherical, brownish; spores roundish or slightly oval, from 2·5 to 4 μ.

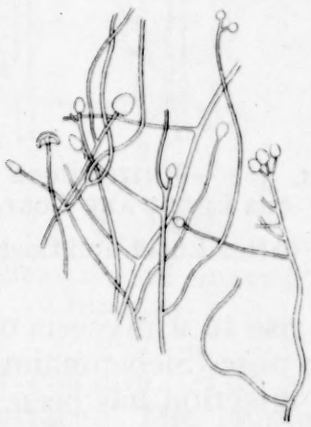

FIG. 369.—RHIZOMUCOR SEPTATUS VON BEZOLD.
(After Siebenmann.)

FIG. 370. — RHIZOPUS NIGER CIAGLINSKI AND HEWELKE.
(After Ciaglinski.)

The spores are of a yellowish or brownish colour; spherical or ovoid, with a smooth surface.

This species was found by Siebenmann in a case of otomycosis.

Genus Rhizopus Ehrenberg 1820.

Rhizoids present; columella hemispheric; mushroom-like.

This genus contains only one species.

Rhizopus niger Ciaglinski and Hewelke 1893.

Synonym.—*Mucor niger* Ciaglinski and Hewelke 1893.

The mycelial filaments are provided with abundant rhizoids forming a snow-white mass. Sporangia globular, of black colour when ripe. Spores ovoid, smooth. Columella is at first globular, but later takes a cylindrical shape, and when the spores have become detached, shows a peculiar mushroom-like appearance.

This species was discovered by Ciaglinski and Hewelke in a case of black mycosis of the tongue.

General Remarks on Mycoses due to Species of the Family Mucoraceæ.—These mycoses are generally called mucormycoses. They have been recorded several times in man.

MUCORMYCOSIS OF THE NOSE.—Several cases are on record in which species of Mucoraceæ (generally *Lichtheimia corimbifera*) were found in various affections of the nose. Their pathogenic rôle in such affections has not been demonstrated with certainty.

MUCORMYCOSIS OF THE TONGUE.—Ciaglinski and Hewelke, and later Seniyiak, have described cases of so-called 'black tongue,' due to *Rhizopus niger*.

MUCORMYCOSIS OF THE EAR—OTOMUCORMYCOSIS.—Several cases are found in the literature (Siebenmann, Böke, Huckel, etc.). Almost always *Lichtheimia corymbifera* was present. In the tropics we have observed two cases in which *L. ramosa* occurred. When the fungus is in great quantity, the patient complains of tinnitus aurium and deafness—the same symptoms as those produced by a plug of cerumen in the external auditory meatus.

MUCORMYCOSIS OF THE LUNGS.—This condition is rare. Fürbringer has described two cases in which *L. corymbifera* was found at the autopsy in some hæmorrhagic foci in the lungs. Lucet, Costantin, and Lambry described a case of bronchitis in a woman due to *Rhizomucor parasiticus*. The expectoration was rather scanty and mucopurulent, but without blood. Mycelial threads and spore-like bodies were present. Cultures were made, and the fungus grown. The condition lasted several months. Potassium iodide was given, and later, owing to the symptoms of iodism, various arsenical preparations.

GENERAL MUCORMYCOSIS.—One case only is on record—that of Paltauf. The patient during life presented fever, slight jaundice, enlargement of the spleen and liver, with signs of diffuse bronchitis and obscure nervous symptoms. At the post-mortem the brain presented several foci of a friable, yellowish substance; the other internal organs showed nodules of various size, some rather hard; others had undergone a purulent change. In all these formations mycelial threads were found; in the lung-nodules fructifications (sporangia) were also present, which enabled Paltauf to determine the fungus as *L. corymbifera*. According to him, the infection must have originated from the intestine, which showed several ulcerative lesions containing the same fungus.

ORDER ASCOMYCETES.

These fungi are characterized by their mode of reproduction—viz., by spores originating inside special cells called *asci*. The spores (ascospores, endospores, gonidia) inside the asci are generally four or eight or a multiple of eight. While these fungi live a parasitic life, no asci are found, and reproduction takes place by germination and conidia. The fungi belonging to this order are often pleomorphic, their morphological characters changing according to the medium on which they live.

The Ascomycetes are divided into two suborders:—

I. *Gymnoascees*.—Asci not enclosed in any special enveloping structure.

II. *Carpoascees*.—Asci produced in special fructifications.

SUBORDER GYMNOASCEES.

Of the *Gymnoascees*, only two families—the Saccharomycetes and the Gymnoasceæ—are parasitic on man.

Family Saccharomycetes.

These organisms are generally round or ovoid cells, presenting a cell wall of single or double contour; the internal protoplasmatic mass often shows granules and vacuoles. During active vegetation as parasites they reproduce by a *budding process*, hence the name of *budding fungi*; when living on artificial media, under unfavourable nutritive conditions, or in the absence of oxygen, they may multiply by formation of endospores or ascospores.

The organisms are, as a rule, unicellular plants, but at times the cells elongate to form mycelial hyphæ—so much so that occasionally a complicated ramifying septate mycelium is produced. This occurs, for instance, when the organisms are cultivated in certain fluid culture media—for example, fluid beer-wort. In such cases side-buds, which separate into conidia-like bodies, may also develop on the hyphæ.

The family Saccharomycetes contains three genera:

I. *Genus Endomyces.*—Reproduction by external spores, ascospores, and spores situated inside the mycelial tubes.

II. *Genus Saccharomyces.*—No true mycelial threads; reproduction by budding and ascospores.

III. *Genus Cryptococcus.*—Reproduction by budding only; no *ascosporses*; no mycelial threads.

IV. *Genus Coccidiodes.*—Temporary genus, not yet well defined.

The fungi belonging to the genus *Saccharomyces*, *Cryptococcus* and *Coccidioides* are commonly known under the name of 'blastomycetes' (or yeasts), while the diseases due to them are termed 'blastomycoses.'

Genus Endomyces Reess 1870.

Reproduction by external spores, ascospores, and spores situated inside the mycelial tubes.

Vuillemin believed at one time that the thrush fungus belonged to this genus. Recent researches carried out also by one of us have demonstrated that the condition known as *thrush* may be caused by various fungi. These fungi, as a rule, do not reproduce by ascospores, and, as justly remarked by Pinoy and Vuillemin himself, belong to the genus *Monilia* (see p. 821). For the fungus isolated once by Vuillemin, which has all the characteristics of the genus *Endomyces*, Landrieu has suggested the term *Endomyces vuillemini*.

Endomyces vuillemini Landrieu 1912.

Synonym.—*Endomyces albicans* Vuillemin 1898.

This fungus was found by Vuillemin in 1898 in thrush patches.

Parasitic Life.—This fungus forms white patches on the tongue and buccal mucosa. The patches are easily detached. A particle of the patch examined under the microscope shows: Septate mycelial threads, simple or ramified, the articles of which are straight or somewhat bent. Each article or cell is about 20 μ in length, and 3 to 5 μ in breadth. At the terminal portion of each mycelial thread three or four shorter ovoid elements are found which reproduce by budding. Some similar ovoid or roundish globular refringent cells can be observed, originating laterally at the septations of the mycelium. These globular elements, which were at first considered to be spores, become detached, and reproduce by germination.

Saprophytic Life—Culture Characters.—The fungus grows well on slightly acid, Sabouraud's and other media; does not grow abundantly in alkaline media; does not ferment lactose and is Gram-positive.

In cultures the fungus appears under two forms: 1. A filamentous form, showing the mycelial threads simple or ramified. 2. A globular form, morphologically similar to a typical yeast, and reproducing by budding. Both forms may be found in the same culture.

The fungus in cultures reproduces by—

1. Chlamydospores or external spores; large globular cells 10 to 20 μ in diameter, with thick resistant walls. The chlamydospores are situate at the terminal extremity of some mycelial hyphæ, and represent modified mycelial articles.

2. Asci containing four ascospores.

3. Internal Spores.—These are oval cells with membrane, protoplasm and nucleus similar to the external spores. The internal spores are arranged in a single string inside some mycelial tubes.

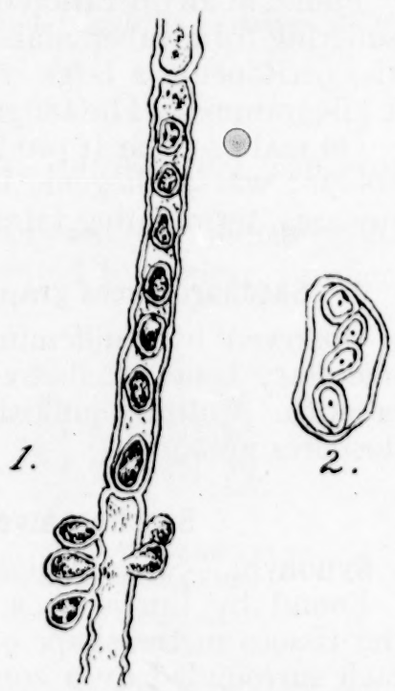

FIG. 371. — ENDOMYCES VUILLEMINI LANDRIEU.

(From a culture. After Vuillemin.)

1, Mycelial threads, with ecdospores and conidia; 2, nasus fructification.

Pathogenicity.—The fungus was found by Vuillemin in a case of *thrush*, a condition generally due to fungi of the genus *Monilia* (see p. 821).

Genus Saccharomyces Meyen 1838.

No proper thallus. Reproduction by budding and endospores or ascospores; fermentation of glucose and saccharose.

As already stated, the fungi of this genus, as well as of the genera *Cryptococcus* and *Coccidioides*, are usually called Blastomycetes, and the diseases induced by them blastomycoses.

The fungi of the genera *Saccharomyces*, *Cryptococcus* and *Coccidioides* have a great importance in dermatology, as they give rise to peculiar

ulcerative affections of the skin, often resembling a syphilide or a tuberculide. The first cases of blastomycosis were observed in America by Posadas, Wernike and others, who at first believed them to be a protozoal infection. Later Gilchrist, Ricketts, and others recognized the true nature of the parasites. Cases of blastomycosis are frequent in tropical countries. By some authors (Sanfelice, Roncali, etc.), cancer has been considered to be of blastomycetic origin.

Saccharomyces blanchardi Guiart 1906.

Found at an operation on a patient who had been considered to be suffering from tubercular peritonitis. The fungus had produced in the peritoneum a large whitish gelatiniform mass, weighing about 1 kilogramme. The fungus grew well on all sugar media.

On maltose agar it produced crateriform colonies of a snow-white colour; was pathogenic to rabbits, in which it induced a general mycosis, terminating fatally.

Saccharomyces granulatus Vuillemin and Legrain 1900.

Observed by Vuillemin and Legrain in a tumour of the submaxillary bone. Cells ovoid, 4 to 5 μ in length, and 3 to 4 μ in breadth. Cultures pinkish or pinkish-red; ascospores and chlamydospores present.

Saccharomyces tumefaciens Busse 1897.

Synonym.—*Saccharomyces subcutaneus tumefaciens* Curtis 1896.

Found by Curtis in a myxomatous tumour. It appeared in the tissues in the shape of spherical bodies 16 to 20 μ in diameter, each surrounded by a zone of amorphous substance. Grows well on all sugar media; in very old cultures ascopores are seen.

Saccharomyces samboni Castellani 1907.

Cells roundish—6 to 8 μ in diameter—easily grown on various media producing white colonies, which rapidly coalesce. Found by Castellani in Ceylon in a few cases of intertriginous dermatitis of the cruro-scrotal region. A similar or identical organism has been observed by Whitfield in England in a case of the same dermatitis.

Saccharomyces ellipsoides Rhees 1870.

Found by Maggiora and Gradenigo in two cases of chronic otitis media. The cells are elliptical, about 6 μ in maximum diameter; presence of ascospores. Maggiora and Gradenigo do not consider this fungus to be pathogenic.

Saccharomyces membranogenes Steinhaus 1906.

Found together with the diphtheria bacillus, in a case of fatal diphtheria. Pathogenic for guinea-pigs, rabbits, and mice.

Saccharomyces hominis Klein and Gordon 1903.

Isolated in some cases of tonsillitis clinically resembling diphtheria. Roundish or oval cells, 5 to 7 μ in diameter. Pathogenic for guinea-pigs and rabbits.

Saccharomyces anomalus Beauverie and Lesieur 1912.

Synonym.—*Willia anomala* Beauverie and Lesieur 1912.

Found by Beauverie and Lesieur in the sputum of a tubercular patient.

Saccharomyces anginæ Vuillemin 1901.

Found by Achalme and Troisier in a case of tonsillitis showing white patches; is easily cultivated.

Saccharomyces balzeri Balzer, Burnier, and Gougerot 1911.

Synonym.—*Parendomyces balzeri* Balzer, Burnier, and Gougerot 1911.

Grows on culture media under the type of oval or roundish yeast-like cells, proliferating by budding. Isolated by Balzer, Burnier, and Gougerot from a gummatous affection.

FIG. 372.—CRATERIFORM COLONIES OF SACCHAROMYCES BLANCHARDI GUIART.
(After Blanchard, Schwartz and Binot, from Brumpt.)

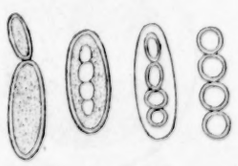

FIG. 373.—SACCHAROMYCES ANGINÆ VUILLEMIN.
(After Trosier and Achalme.)

Saccharomyces roseus Maggiora and Gradenigo 1890.

Found by Maggiora and Gradenigo in the Eustachian tube, and considered by them to be non-pathogenic. Cultures of pink colour.

Genus Cryptococcus Kützing 1843.

Reproduction by budding only; endospores and ascospores unknown; most species do not ferment sugar media (glucose and saccharose).

Cryptococcus dermatitis Gilchrist and Stokes 1898.

Synonyms.—*Blastomyces dermatitis* Gilchrist and Stokes 1898, *Cryptococcus gilchristi* Vuillemin, *Zymonema gilchristi* de Beurmann and Gougerot.

Found by Gilchrist and Stokes in a case of chronic ulcerative dermatitis, and later in a case which had been diagnosed as a tuberculide of the skin. After Gilchrist and Stokes's cases, other cases of blastomycosis due to an identical or similar organism have been described by Hyde, Oppenheim, Ricketts, and others. Ricketts

ulcerative affections of the skin, often resembling a syphilide or a tuberculide. The first cases of blastomycosis were observed in America by Posadas, Wernike and others, who at first believed them to be a protozoal infection. Later Gilchrist, Ricketts, and others recognized the true nature of the parasites. Cases of blastomycosis are frequent in tropical countries. By some authors (Sanfelice, Roncali, etc.), cancer has been considered to be of blastomycetic origin.

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Saccharomyces balzeri Balzer, Burnier, and Gougerot 1911.

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FIG. 372.—CRATERIFORM COLONIES OF SACCHAROMYCES BLANCHARDI GUIART.
(After Blanchard, Schwartz and Binot, from Brumpt.)

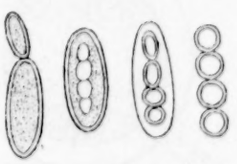

FIG. 373.—SACCHAROMYCES ANGINÆ VUILLEMIN.
(After Trosier and Achalme.)

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Found by Maggiora and Gradenigo in the Eustachian tube, and considered by them to be non-pathogenic. Cultures of pink colour.

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considered these fungi to be species of *Oidium*, and proposed the name '*oidiomycosis*' to indicate the disease produced by them.

C. gilchristi in the affected tissues has the appearance of a typical yeast—*i.e.*, large, globular cells, 10 to 16 μ in diameter, reproducing by budding. In cultures, besides these globular elements, rudimentary mycelial tubes may occasionally be found, presenting lateral or terminal conidia; ascospores are absent. The fungus does not ferment glucose or saccharose.

Cryptococcus hominis Vuillemin 1901.

Synonyms.—*Saccharomyces* (sp. ?) Busse 1894, *Atelosaccharomyces busse-buschki* de Beurmann and Gougerot 1909, *Atelosaccharomyces rudeli* de Beurmann and Gougerot 1911.

Found in abscesses in a woman by Busse. In the pus the fungus presented itself in the shape of oval bodies, with a membrane having

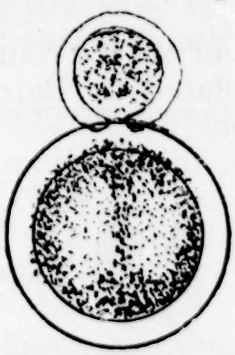

FIG. 374. — CRYPTOCOCCUS GILCHRISTI VUILLEMIN. (After Gilchrist.)

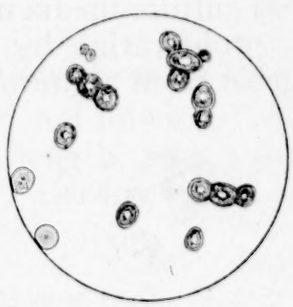

FIG. 375.—CRYPTOCOCCUS LINGUÆ PILOSÆ LUCET. (After Lucet, from Brumpt).

a double contour. These elements were arranged in groups, each group being surrounded by a capsule. Culturally the fungus showed only roundish budding forms, no mycelium, no asci.

Cryptococcus linguæ-pilosæ Lucet 1901.

Synonym.—*Saccharomyces linguæ-pilosæ* Lucet 1901.

Found by Lucet and others in cases of so-called 'black tongue.' It appears on the surface of the hypertrophied lingual papillæ in the shape of roundish bodies, with double contour, 3 to 6 μ in diameter. Grows easily on sugar media. Attempts to reproduce the disease have failed.

The condition known under the name of 'lingua nigra' is caused in addition to the above fungus, in some cases by *Rhizopus niger*, in other cases by *Nocardia lingualis*.

Cryptococcus plimmeri Costantin 1901.

Found by Plimmer in many cases of cancer; is probably only a saprophyte. In the tissues roundish bodies of various sizes, 4 to

40 μ in diameter are seen, occasionally budding, and either free or intracellular. Cultivation has succeeded only on one occasion.

Cryptococcus degenerans Vuillemin 1896.

Synonym.—*Blastomyces vitrosimile degenerans* Roncali 1896.

Found by Roncali and others in malignant tumours, sarcomata, and carcinomata. Easily grown; on potatoes it attains a much larger size than on any other medium. Pathogenic for guinea-pigs.

Cryptococcus corsellii Neveu-Lemaire 1908.

Found by Corselli and Frisco in a sarcoma of the mesenteric glands. The fungus appeared in the tumours under the shape of black masses. It was easily cultivated, and found pathogenic to guinea-pigs, rabbits, and dogs.

Cryptococcus hessleri Rettger 1904.

Synonym.—*Blastomyces hessleri* Rettger 1904.

Isolated by Hessler from a small tumour which developed on a patient after a razor-cut. Easily cultivated, especially on alkaline media. Pathogenic for the rabbit and guinea-pig.

Cryptococcus breweri Verdun 1912.

Synonym.—*Atelosaccharomyces breweri* Verdun 1912.

Found by Brewer and Wood in an abscess of the vertebral column. Reproduction by budding only. Does not ferment any sugar.

Cryptococcus tonkini Legendre 1911.

Synonym.—*Blastomyces tonkini* Legendre 1911.

Found by Legendre in two cases of blastomycosis in Indo-China. Pinoy considers that the characters given are not sufficient to create a new species for it.

Cryptococcus sulfureus Beauverie and Lesieur 1912.

Found by Beauverie and Lesieur in certain pharyngeal lesions of a case of typhoid. Ferments slightly dextrose, saccharose, and lactose.

Cryptococcus lesiewurii Beauverie and Lesieur 1912.

Found in a case of stomatitis. Ferments dextrose only.

Cryptococcus salmoneus Sartory 1911.

Described by Sartory. Found in cases of stomatitis.

Cryptococcus guillermondi Beauverie and Lesieur.

Found by Guillermond and Lesieur in cases of stomatitis.

Genus Coccidioides Rixford and Gilchrist 1897.

Temporary genus not yet well defined, with intermediate characters between *Saccharomyces* and *Monilia*. One species only: *Coccidioides immitis* Stiles 1897.

Coccidioides immitis Stiles 1897.

Synonyms.—*Coccidioides pyogenes* Rixford and Gilchrist 1897, *Oidium coccidioides* Ophüls 1905, *O. protozoides* Ophüls 1905, *Posadasia esferiforme* Canton 1898, *Oidium immitis* Verdun 1907.

Discovered by Wernicke in 1882 in America in a patient with patches resembling a tuberculide, and gummata. In the lesions roundish bodies are seen of various sizes, 3 to 80 μ in diameter, with a well-defined thick membrane. Inside some of the bodies, numerous spores may be seen.

Cultures.—The fungus grows under two types: (1) a saccharomyces-like type, reproducing by budding; (2) a filamentous type.

The colonies are roundish, slightly elevated, but deepening into the medium. They are grey or white, but when old often become brownish. In old cultures chlamydospores may be present. The biochemical properties of the fungus are not known.

Pathogenicity.—The fungus induces in man a type of blastomycosis. It is pathogenic to monkeys, mice, guinea-pigs, and rabbits. It probably lives saprophytic in nature.

Family Gymnoasceæ.

Spherical perithecium, the walls of which are formed by mycelial filaments. At the extremities of these mycelial threads ascus fructifications are found. Besides vegetating under this type, the Gymnoasceæ can also vegetate under a filamentous or conidial form without any formation of asci. It is under this second form that most of the Gymnoasceæ parasitic on man vegetate.

The genera *Microsporon*, *Trichophyton*, *Achorion*, are at the present time considered to belong to the family Gymnoasceæ on account of the following facts:—

1. These three genera, as demonstrated by Matruchot and Dassonville, have the greatest resemblance to the filamentous type of some typical Gymnoasceæ.

2. A species of Gymnoasceæ, *Ctenomyces serratus*, when living saprophytically, shows perithecia and ascus fructifications; when inoculated into animals, vegetates under a filamentous form very similar to a *Trichophyton*, and gives rise to a *Trichophyton* eruption.

The genera of the Gymnoasceæ containing human parasitic species are the following: (1) *Microsporon*; (2) *Trichophyton*; (3) *Epidermophyton*; (4) *Achorion*; (5) *Endodermophyton*; (6) *Lophophyton*; (7) *Oospora*; (8) *Montoyella*.

Genus Microsporon Gruby 1843.

The fungi belonging to this genus are generally parasitic in the hairs and hair follicles, but may attack glabrous parts. When parasitic in the hairs, they are characterized by the mycelial spores being roundish, small (2 to 3 μ), and irregularly arranged in a mosaic-like manner. They are easily cultivated on Sabouraud's and other sugar media (see Genus *Trichophyton*, p. 778). In cultures

the microsporons proliferate by *sprouting* with branching of the mycelium ; and also, often, by—

1. *Spore-Bearing Hyphæ*—of type *Acladium*, the conidia being oval, 3 to 4 μ in length, and 2 to 3 μ in breadth. They are not supported by short stigmata, as is the case in the genus *Trichophyton*.

2. *Terminal Septate or Non-Septate Spindles*.—These structures are found at the end of certain filaments, and may be considered to be modified terminal conidia. They are large fusiform structures, 30 to 60 μ in length, and 15 to 18 μ in breadth. They have granular contents, and may be septate or non-septate. The surface, especially at the apex, presents some peculiar hair-like formations which are not observed in the spindles of the fungi of the genus *Trichophyton*.

3. *Chlamydospores*.—Certain mycelial articles become expanse, ovoid, or ampulliform, 12 to 18 μ in length, and 6 to 8 μ in breadth. Their protoplasm may be granular, and the membrane may become much thicker and have a double contour. These elements are chlamydospores. They are generally found when the fungi vegetate under unfavourable conditions. Another structure often seen in fungi of the genus *Microsporon* are the so-called *denticulate* or *pectinate bodies*, which are mycelial segments, generally curved, showing on one side—the convex side as a rule—several small protruding processes. Bodin has demonstrated these processes to be mycelial tubes arrested in their development.

Pleomorphism.—After a time, and often rapidly, the cultures of microsporons lose their characteristics and become pleomorphic. This phenomenon is not very prominent, however, in the most important species—viz., *Microsporon audouini*, while it is very accentuated in some microsporons of animal origin, especially *M. minimum*, in which, according to the complete investigation carried out by Bodin, two types may be met with :—

1. THE DOWNY TYPE (*Acladium type*).
2. THE GLABROUS TYPE (*Endoconidium type*).

1. THE DOWNY TYPE is found on the ordinary sugar media in which there is an abundant development of white duvet. Microscopically, fructifications of the type *Acladium* are seen, the spore-bearing hyphæ presenting numerous lateral sexile conidia. Subcultures will always give rise to the same downy type.

2. THE GLABROUS TYPE is observed on wart agar. The growth has a smooth surface, without duvet. Microscopically, short strings of hyaline ovoid or cylindrical conidia are seen inside the terminal segments of the fertile hyphæ. Lateral conidia are absent.

Mode of Infection.—Infection takes place from man to man in the case of microsporons of human origin ; from the lower animals to man in the case of microsporons of animal origin. The human microsporons (*M. audouini*, *M. velveticum*, *M. umbonatum*, *M. tardum*) do not seem to be inoculable into the lower animals.

TABLE SHOWING MICROSPORONS PARASITIC ON MAN.

Genus.		Species.
Microsporon Gruby 1843	of human origin	M. audouini Gruby 1843.
		M. velveticum Sabouraud 1907.
		M. umbonatum Sabouraud 1907.
		M. tardum Sabouraud 1909.
	of animal origin	M. minimum Le Calvé et Malherbe 1898.
		M. lanosum Sabouraud 1907.
		M. felineum C. Fox and Blaxall 1896.
		M. fulvum Uriburu 1907.
		M. pubescens Sabouraud 1909.
		M. villosum Minne 1907.
		M. tomentosum Pelágatti 1909.
		M. iris Pasini 1912.
		M. flavescens Horta 1912.
		M. depauperatum Guéguen 1912.

Some species (*M. audouini*, *M. velveticum*, *M. umbonatum*, *M. tardum*) seem to be parasitic on man only; others (*M. lanosum*, *M. felineum*, *M. minimum*, etc.) are parasitic on the lower animals, but occasionally infect man.

Microsporon audouini Gruby 1843.

This parasite was described by Gruby in 1843, but his investigation was forgotten, till Sabouraud, in his classical researches on ringworm in 1892, demonstrated the plurality of species of the fungi found in this affection, and showed that a form of tinea capitis was due to the microsporon described by Gruby.

Parasitic Life.—Around the affected hairs the fungus forms by means of its mycelial spores a white opaque sheath, extending 2 or 3 millimetres above the opening of the hair follicle. The sheath is composed of a mosaic of small, roundish, or polyhedral spores, the diameter of which varies between 2 and 3 μ. In the interior of the hair a few mycelial filaments of the fungus may be observed. The fungus very seldom attacks glabrous parts of the body.

Saprophytic Life—Cultures.—*Microsporon audouini* grows well on Sabouraud's maltose agar and other media. The rate of growing is slow. In maltose agar the growth becomes evident about a week after inoculation under the appearance of a plaque of a so-called 'satiny aspect,' beneath the surface. In a few days more, aerial hyphæ develop, extending above the surface. When the development is complete—generally this takes about six to eight weeks—the growth is roundish, covered with short greyish duvet, and presents often a central knob, and some concentric rings of a whitish-greyish colour. The cultural characters, however, are variable, and pleomorphinism occurs. The cultural characters have been thoroughly investigated by Sabouraud, Fox and Blaxall, Bodin, and others. The fungus very slowly liquefies gelatine; on potatoes it produces a brownish discoloration compared by Sabouraud to the colour of dried blood.

Reproduction.—This takes place—

1. By sprouts from the mycelial tubes.

2. By small terminal and lateral conidia, there being spore-bearing hyphæ of type Acladium (see Fig. 376).

3. By large unilocular or multilocular spindle conidia. These spindles are large structures 30 to 60 μ in length, and 15 to 18 μ in breadth. They may be septate or non-septate.

4. By formation of chlamydospores.

Pathogenicity.—*Microsporon audouini* causes the most obstinate form of tinea capitis. The patches affected are often large, scaly, and present stumps, provided with an opaque whitish sheath. It seldom attacks glabrous parts of the body. *M. audouini* is extremely common in England; but rare in the South of Europe

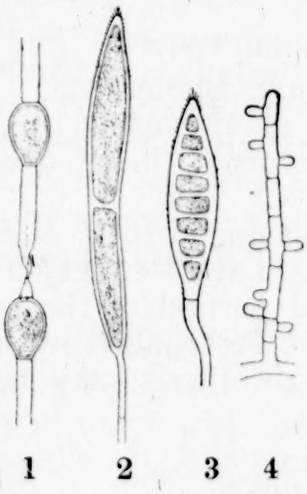

FIG. 376.—MICROSPORON AUDOUINI GRUBY.

(After Bodin.)

1, Chlamydospores; 2, spindle; 3, pluriseptate spindle; 4, spore-bearing hypha, type Acladium.

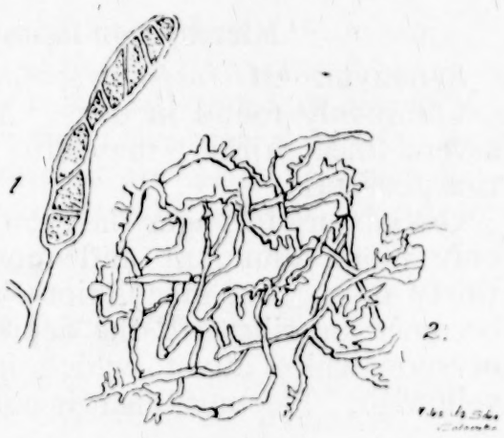

FIG. 377.—MICROSPORON AUDOUINI GRUBY.

(From cultures.)

1, Septate spindle body; 2, mycelium, with denticulated structures.

Italy), and extremely rare in the tropics. We have never seen cases of ringworm due to *M. audouini* in Equatorial Africa or Ceylon, but a few cases have been described in Brazil, in Madagascar, and in Senegal.

M. audouini seems to live only on the human subject, but closely allied species have been found by Fox in cats, by Bodin in dogs, and by Bodin, Fox, and others, in horses.

Microsporon velveticum Sabouraud 1907.

Resembles closely *M. audouini*, but the cultures are more velvety, the duvet being white instead of greyish, and of closer growth. Not inoculable into guinea-pigs. This species seems to be fairly common in North America.

Microsporon umbonatum Sabouraud 1907.

Found by Sabouraud in two cases of microsporosis of the scalp contracted in Russia. The appearance of the growth when it has reached complete development (about twenty-five to thirty days after inoculation) has been compared by Sabouraud to the appearance of an ancient round shield, with a central conical formation representing the *umbo* of the shield. Not inoculable into guinea-pigs.

Microsporon tardum Sabouraud 1909.

Found by Sabouraud in cases of microsporosis capitis to be clinically identical with the type caused by *M. audouini*. Differs from *M. audouini* by the growth being much slower and scantier, and the duvet being shorter.

Microsporon lanosum Sabouraud 1907.

Synonym.—*Microsporon audouini var. canis* Bodin 1897.

Commonly found in dogs. May affect man, causing a type of severe tinea capitis; may also produce forms of tinea barbæ and tinea corporis.

On Sabouraud's agar the growth is at first similar to *M. audouini*, only more abundant and more downy. Later—twenty-five to thirty days from inoculation—the central portion of the growth becomes umbilicated, the depression being surrounded by a ring of snow-white duvet, which in very old cultures may become yellowish. Pleomorphism is common.

Microsporon felineum C. Fox and Blaxall 1896.

Common in the cat in England, North America, and Belgium; may infect man, attacking hairy and non-hairy regions of the body. On Sabouraud's agar the growth is rather abundant, discoid, with flattened surface, showing no furrows, and covered with a large amount of grey duvet. The fungus is easily inoculable into cats, dogs, and guinea-pigs.

Microsporon minimum Le Calvé and Malherbe 1898.

Synonyms.—*Microsporon audouini var. equinum* Bodin 1896, *Trichophyton minimum* Le Calvé and Malherbe 1898.

Very common in foals; may infect man, giving rise to a mild type of tinea corporis, which gets cured spontaneously.

On Sabouraud's and glucose agar the growth is deeply furrowed, and, in contrast to all other microsporons, duvet is absent, or, when present, is very scanty, very short, and of a pinkish colour.

Microsporon fulvum Uriburu 1907.

Found by Uriburu in cases of tinea capitis in the Argentine. It grows very rapidly on Sabouraud's agar, the growth presenting a central *umbo*, or projection, surrounded by a brownish powdery ring. The peripheral zone of the growth is covered with white duvet.

Microsporon pubescens Sabouraud 1909.

Discovered by Sabouraud in a case of tinea capitis contracted in New York. It grows rapidly on Sabouraud's medium, the culture being characterized by the presence of abundant but very delicate silky duvet. At complete development—about thirty days from inoculation—the growth may have a flattened surface, or some furrows, radiating from the centre, may be present. The central portion, which is covered with rather long, white duvet, is encircled by a zone of powdery appearance ; outside this there is the peripheral zone covered by the extremely delicate characteristic silky-like duvet.

Microsporon villosum Minne 1907.

Found in Belgium by Minne in a child suffering from ringworm of the hair clinically identical with the type caused by *M. audouini*. On Sabouraud's agar the growth at complete development is about 6 centimetres in diameter; the central portion is flattened, with powdery, slightly brownish surface. This is surrounded by mammillary, downy formations, which decrease in size towards the periphery.

Microsporon tomentosum Pelagatti 1909.

Found by Pelagatti in Sardinia in a case of microsporosis capitis, clinically identical with the usual type caused by *M. audouini*. It grows rapidly on Sabouraud's agar. The growth at complete development has a somewhat flattened appearance, but several furrows are present, originating from the central portion, which may be umbilicated. The whole surface is covered by thin white duvet.

Microsporon iris Pasini 1911.

Discovered by Pasini in Italy in some cases of microsporosis capitis, clinically somewhat different from the usual type. The fungus grows well on Sabouraud's agar. At complete development—twenty-two to twenty-six days from inoculation—the growth presents a central knob covered with white duvet, and surrounded by white and brick-red rings, alternating.

The microsporosis capitis due to this microsporon is characterized by the hairs remaining nearly of normal length, and presenting a white-greenish discoloration.

Microsporon flavescens P. Horta 1912.

Isolated by Horta from some circinate squamous patches situate on the neck of a child in Brazil. Grows rapidly on Sabouraud's agar: the growth is of a yellow colour ; there is a depression at the centre, from which radiate four or five shallow furrows. Pleomorphic duvet appears quickly.

Microsporon depauperatum F. Guéguen 1912.

Isolated by Guéguen from some circinate, dry, squamous patches. In cultures the membrane of some nucleal filaments presents peculiar thickenings. Spore-bearing hyphæ are not so well differentiated as in other species.

Genus Trichophyton Malmsten 1848.

The mycelial spores, as found in the affected parts and hairs, are large (4 to 7 μ). In cultures reproduction takes place by conidia, supported by short sterigmata, and terminal spindles. Presence of spiral hyphæ. Hairy and non-hairy parts of the body may be attacked.

General Considerations.—During their parasitic life the species of the genus *Trichophyton* vegetate according to two types: (1) mycelial filaments; (2) mycelial spores.

The mycelial filaments consist of long cylindrical cells, separated by septa. The so-called mycelial spores are simply a modification of the mycelial filaments, due to the septa being much closer, so that the cells limited by them are almost as broad as they are long. The term 'mycelial spores' is incorrect, as they are not organs of reproduction, but only vegetative organs.

When the shape of these mycelial spores or sporulating mycelia is roundish or oval, the filament takes a moniliform appearance. Moreover, these cells are easily dissociated. Such a type is called 'fragile mycelium.' To this type belongs, for instance, *Trichophyton sabouraudi* R. Blanchard.

When the mycelial spores are square, the filament straight, and its articles long, the mycelium is called 'resistant.' This type is observed, for example, in *Trichophyton tonsurans* Malmsten.

Cultivation.—Most *Trichophytons* can be cultivated, some cannot. The best medium is Sabouraud's maltose agar, the composition of which is the following:—

Maltose	4 grammes.
Peptone Chassaing	1 gramme.
Agar	1·50 grammes.
Distilled water	100 c.c.

On this medium, however, pleomorphism is of frequent occurrence.

Pleomorphism.—Cultures on maltose and other sugar agars of all *Trichophytons*, with the single exception of *T. sabouraudi*, becoming old, lose their characteristics and become covered with abundant white duvet. In these cultures, which can be considered degenerate, and are generally called 'pleomorphic,' organs of fructification are usually absent. By transplanting these cultures, the same pleomorphic, downy type of growth will be obtained; never again will the growth show the characteristics of the original *young* cultures directly obtained from the lesions. It is impossible to return to the original type, even by animal inoculations.

To prevent pleomorphism, Sabouraud advises the following medium :

Agar	1·8 grammes.
Pepton Chassaing	3 to 5 grammes.
Water	100 c.c.

On this medium the growth of the various *Trichophytons* is much less abundant than on sugar media, but the cultures are fairly characteristic, and do not become pleomorphic.

Experimental Inoculations.—Certain *Trichophytons* can be easily inoculated experimentally into man and many of the laboratory animals—guinea-pigs, rabbits, etc. Sabouraud advises the inoculation of portions of the cultures to be made into a small flictena, artificially induced by burning, such as by applying to the skin a lighted match.

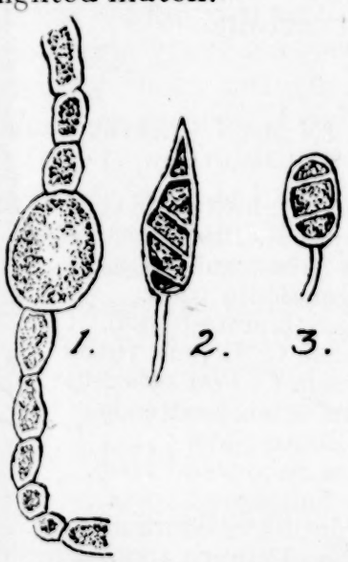

FIG. 378.—TRICHOPHYTON. (Preparation from cultures, after Bodin.)

1, Chlamydospore ; 2 and 3, septate spindle bodies.

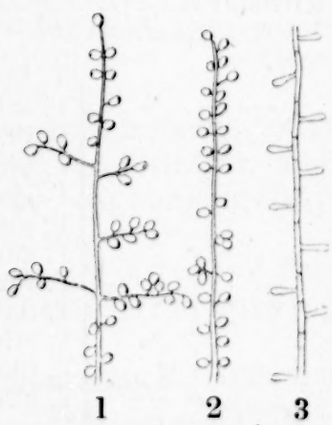

FIG. 379.—FRUCTIFICATIONS.

1, 2, Spore-bearing hyphæ (*Trichophyton*) ; 3, spore-bearing hypha (*Microsporon*).

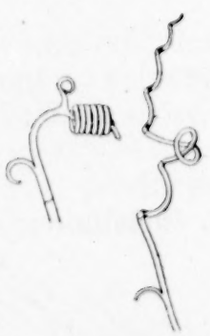

FIG. 380.—TRICHOPHYTON : SPIRAL BODIES.

The *intravenous* injection may induce generalized lesions of the internal organs.

The intraperitoneal injection as done by Citron may induce a type of peritoneal pseudo-tuberculosis.

Mode of Infection.—Infection may take place from man to man—this is generally the case with *Trichophytons* of the group *endothrix*—or from the lower animals to man—this is usually the case with the *Trichophytons* of the endo-ectothrix and ectothrix type. There is also little doubt that *Trichophytons* may live saprophytically in nature, this explaining sporadic cases of trichophytoses in man.

Reproduction.—This takes place by—

1. Lateral and terminal conidia, supported by short sterigmata.
2. Chlamydospores ; these are rare.
3. Large terminal septate and unseptate spindles.

Classification.—*Trichophytons* can be divided into the following groups :—

I. ENDOTHRIX.—The fungus develops in the interior of the hair ; does not cause suppuration ; and is of human origin only.

II. ECTOTHRIX (ENDO-ECTOTHRIX).—The fungus is present only on the surface of the hair, or both on the surface, forming a sheath, and in the interior ; often pyogenic, and of animal origin. They are divided into two groups—those having small spores (type microïdes) and those having large spores (type megalosporon).

III. TRICHOPHYTONS NOT INVADING THE HAIRS AND HAIR FOLLICLES.—The fungi do not attack the hair or hair-follicles, and do not cause suppuration.

The species constituting the third group are : *T. albiscicans, T. blanchardi, T. ceylonense, T. macfadyeni.* It is to be noted that the botanical position of these fungi is not yet certain.

TABLE SHOWING TRICHOPHYTONS FOUND IN MAN (PARTLY FROM SABOURAUD).

I. Endothrix			T. tonsurans Malmsten 1845. T. sabouraudi R. Blanchard 1895. T. pilosum Sabouraud 1909. T. violaceum Bodin 1902. T. glabrum Sabouraud 1909. T. soudanense C. Joyeux 1912. T. sulphureum C. Fox 1908. T. fumatum Sabouraud 1909. T. flavum Bodin 1902. T. effractum Sabouraud 1909. T. plicatile Sabouraud 1909. T. circonvolutum Sabouraud 1909. T. exsiccatum Uriburu 1909. T. polygonum Uriburu 1909. T. regulare Sabouraud 1909. T. umbilicatum Sabouraud 1909.
II. Ectothrix (endo-ectothrix)	Type microïdes (small spores)		T. mentagrophytes Ch. Robin 1853. T. farinulentum Sabouraud 1910. T. persicolor Sabouraud 1910. T. granulosum Sabouraud 1908. T. lacticolor Sabouraud 1910. T. radiolatum Sabouraud 1910. T. felineum R. Blanchard 1895. T. denticulatum Sabouraud 1910.
	Type megalosporon (large spores)	Faviform type	T. verrucosum Bodin 1902. T. ochraceum Sabouraud 1909. T. album Sabouraud 1909. T. discoides Sabouraud 1909.
		Downy type	T. equinum Gedoelst 1902. T. rosaceum Sabouraud 1902. T. vinosum Sabouraud 1910. T. nodoformans Castellani 1912.
III. Not attacking the hairs (tropical trichophytons)			T. albiscicans Vieuwenhuis 1907. T. blanchardi Castellani 1905. T. ceylonense Castellani 1908. T. macfadyeni Castellani 1905.

I. *Trichophytons endothrix.*

Trichophyton tonsurans Malmsten 1845.

Synonyms.—*Trichomyces tonsurans* Malmsten 1845, *Oidium tonsurans* Zopf 1890, *T. megalosporum endothrix* Sabouraud 1894, *T. crateriforme* Bodin 1902, which is the term in current use in dermatological literature.

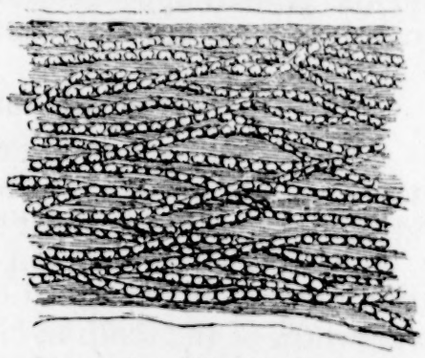

FIG. 381.—TRICHOPHYTON TONSURANS MALMSTEN. (Preparation of a hair in liquor potassæ, after Sabouraud.)

Causes a type of tinea capitis somewhat rare in England, but common on the Continent. The hairs are broken 2 to 4 millimetres from the scalp, and the stumps are variously bent. The diseased hairs have a powdery, greyish appearance, and on pulling them out the roots are not black, as in normal hairs. It belongs to the type Endothrix. The mycelial cells are large (4 to 5 μ), quadrangular (so-called resistant mycelium type). Grows well on maltose agar and other media; on maltose agar colonies are white or yellowish, often crateriform, and present a velvety surface at first, later powdery. In hanging-drop cultivations spore-bearing fructifications can be seen.

T. tonsurans, besides producing a type of tinea capitis, produces also a form of tinea corporis and a trichophytosis of the nails.

Trichophyton sabouraudi R. Blanchard 1895.

Synonym.—*Trichophyton acuminatum* Bodin 1902. This is the term commonly used in dermatological works.

This *Trichophyton* is of the type Endothrix. Mycelial threads have a moniliform appearance, and their articles become easily dissociated (so-called fragile mycelium). Grows well on maltose agar, giving rise to conical white colonies; often acuminate with central plumes, and occasionally may present yellowish or pinkish rings; older cultures may present a powdery surface of a dark pinkish colour. Pleomorphism always absent. In hanging-drop cultures aerial filaments with lateral conidia are seen.

T. sabouraudi causes a form of tinea capitis called by Sabouraud 'tondante peladoide,' and also a variety of tinea circinata.

The tinea capitis induced by this fungus is also known under the name of 'black-dotted ringworm.' The hairs get broken lower than in the type of ringworm caused by *T. tonsurans*. The stumps are on the same level as the surface of the scalp, and appear as black dots.

Trichophyton pilosum Sabouraud 1909.

Very similar to *T. sabouraudi*, from which it differs only by the cultures being covered, when old, by a dense, short, white duvet.

Trichophyton soudanense C. Joyeux 1912.

Endothrix; very similar to *T. tonsurans*. In the hairs the mycelial spores are generally rectangular, arranged in long strings. On Sabouraud's agar the growth appears three to four days after inoculation as a small yellow nodule; later, the peripheral portion of the growth appears white. It has been found by C. Joyeux in cases of tinea capitis in the Sudan.

Trichophyton violaceum Bodin 1902.

Discovered by Sabouraud in cases of tinea barbæ; type Endothrix. The growth on maltose agar is of a light brownish or greyish colour, with moist surface, and later becomes violet.

This species is common in Italy and North Africa. In Ceylon this fungus, or a variety of it, produces a type of very common ringworm of the scalp in children, with white patches covered by enormous numbers of pityriasic squamæ. The patches remain permanently bald. The Ceylon fungus is endo-ectothrix, and although culturally is hardly distinguishable from *T. violaceum*, may possibly be a different variety (var. *decalvans* Castellani).

Trichophyton glabrum Sabouraud 1909.

Closely allied to *T. violaceum*, but shows a more rapid growth, and no violet pigmentation develops. Surface smooth and moist.

Trichophyton sulphureum C. Fox 1908.

Described by Colcott Fox in some cases of tinea capitis in England. Endothrix type. On Sabouraud's agar the growth is characterized by a central reddish nodule, which later becomes crateriform, assuming a speckled appearance. The rest of the culture has a delicate but distinct primrose or sulphur colour.

Trichophyton flavum Bodin 1902.

Synonym.—*Trichophyton cerebriforme* Sabouraud 1909.

Differs from *T. tonsurans* by the cultures being cerebriform, and by becoming creamy-white when old.

Pathogenicity.—Induces a type of tinea corporis and a form of sycosis. Inoculable into guinea-pigs.

Trichophyton plicatile Sabouraud 1909.

Colonies closely resemble those of *T. tonsurans*, but have a creased appearance with white, powdery surface. Found by Sabouraud in cases of sycosis. Sequeira has observed it in a case of trichophytic granuloma.

Trichophyton circonvolutum.

Endothrix; somewhat similar to *T. plicatile;* the growth has a convoluted surface. Found by Sabouraud in cases of trichophytosis contracted in the Sudan and Dahomy.

Trichophyton exsiccatum Uriburu 1909.

Found in Argentina by Uriburu. Endothrix ; very slow growth ; crateriform colonies, with surface finely cracked, and of a dry aspect.

Trichophyton polygonum Uriburu 1909.

Endothrix. The growth is at first roundish, then takes a characteristic polygonal outline. The central part is crateriform.

Trichophyton regulare Sabouraud 1909.

Endothrix ; very similar to *T. tonsurans*, the cultures being at first crateriform ; then, the edges of the crater becoming undermined, the growth takes a peculiar pouch-like shape, with several radiating small sulci. The characters of the fungus show always the greatest regularity, never changing ; hence the name *T. regulare* given to it by Sabouraud. This fungus was found by Dalla Farera.

Trichophyton umbilicatum Sabouraud 1909.

Endothrix ; cultures are deeply umbilicated ; present at the periphery fine radiating hyphæ, forming a sort of aureola.

Trichophyton fumatum Sabouraud 1909.

Cultures crateriform taking when old a yellowish-brownish colour, compared by Sabouraud to the colour of a dead leaf. This *Trichophyton* is fairly common in some parts of Italy.

Trichophyton effractum Sabouraud 1909.

Cultures at first very similar to those of *T. tonsurans*, being crateriform ; when old, the growth becomes very dry, and the surface splits from the edge.

II. *Trichophytons Endo-Ectothrix.*

Trichophyton mentagrophytes Ch. Robin 1853.

Synonyms.—*Microsporon mentagrophytes* Robin 1853, *Sporotrichum mentagrophytes* Soccardo 1886, *Trichophyton gypseum* Bodin 1902, *T. asteroides* Sabouraud 1909.

Endo-ectothrix ; mycelial spores are mostly situated outside the cuticle of the hair, while a few are found in the interior. The latter are 5 to 6 μ in size ; those outside, forming the parasitic sheath, are of very unequal size (2 to 11 μ).

On Sabouraud's agar the growth is of white colour ; the centre is somewhat elevated and covered by duvet ; the rest of the growth has a powdery surface, and often presents several radiating furrows. At the periphery numerous tapering projections are observed. This *Trichophyton* is of animal origin, being found in horses, cows, dogs, and, perhaps, pigs and sheep. In man, it is pyogenic, causing a type of trichophytic sycosis, kerion, and also a pustular type of tinea corporis.

The following five species are very closely allied to *T. mentagrophytes* :—

Trichophyton farinulentum Sabouraud 1910.

Synonym.—*Trichophyton gypseum* Bodin 1902 *pro parte.*

Found in cases of kerion by Sabouraud. On maltose agar the growth is at first discoid, umbilicated, with a white powdery surface and several radiating furrows. Later, the central part becomes raised, forming a knob covered with white duvet. On agar media not containing sugars the growth is at first smooth, without any duvet, of moist appearance and yellow colour; while later the central part becomes downy, and the peripheral portions take a powdery aspect.

Trichophyton persicolor Sabouraud 1910.

Synonym.—*Trichophyton gypseum* Bodin 1902 *pro parte.*

Found by Sabouraud in cases of pustular ringworm of the palms of the hands and of the beard. In contrast to all other species of *Tricophytons*, it grows better on agar without sugar than on sugar media. The cultures are of a pinkish-reddish colour. The appearance of the colonies has been aptly compared by Adamson to the skin of a very ripe peach.

Trichophyton granulosum Sabouraud 1908.

Synonym.—*Trichophyton gypseum* Bodin 1902 *pro parte.*

The growth on Sabouraud's agar is discoid, often umbilicated; powdery surface of a white-yellowish colour, with granular formations or prominences dotted all over.

This *Trichophyton* is found in the horse, in which it produces a peculiar type of trichophytosis, with extremely numerous, very small, patches. It has been observed in man in Italy by Dalla Farera.

Trichophyton lacticolor Sabouraud 1910.

Synonym.—*Trichophyton gypseum* Bodin *pro parte.*

The cultures are discoid, flattened, with shallow furrows radiating from the centre. The colour is cream-white, with occasionally a slight yellow tinge. In old cultures there is abundant pleomorphic duvet. Can easily be inoculated into the guinea-pig.

Trichophyton radiolatum Sabouraud 1910.

Synonym.—*Trichophyton gypseum* Bodin *pro parte.*

Isolated by Sabouraud from cases of kerion. Very similar to *T. mentagrophytes*, from which it differs in cultures by the colour being of less pure white, and by the radiating projections being less marked or absent. After three to four weeks abundant white pleomorphic duvet appears.

Trichophyton felineum R. Blanchard 1895.

Synonyms.—*Trichophyton niveum* Sabouraud, *T. radians* Sabouraud 1909.

Endo-ectothrix; causes often a pustular ringworm of the body; less frequently attacks the hairs. In the pustules free spores and a few mycelial elements are seen; in the affected hairs the spores forming the parasitic sheath are of large dimensions, 7 to 9 μ in diameter. The growth on Sabouraud's medium is umbilicated, with a white powdery surface and numerous radiating projections at the periphery.

Pathogenicity.—This fungus is found in the cat, and probably also in horses, cattle, dogs, sheep, and pigs. In man it causes a type

of kerion celsi and also a type of vesiculo-pustular tinea corporis, called by Sabouraud ' trichophytosis circinata disidriformis,' and ' herpes iris vesiculosus ' by Biett.

Trichophyton denticulatum Sabouraud 1910.

Synonym.—*Trichophyton niveum* Sabouraud *pro parte.*

Almost identical with *T. felineum*, but in cultures the radiating projections are much shorter and more pointed.

Trichophyton verrucosum Bodin 1895.

Endo-ectothrix, megalosporon, faviform. This fungus, though producing typical trichophytic lesions when parasitic, shows cultural characters somewhat similar to an achorion, the growth, which is white, being often convoluted or cerebriform. It is found in donkeys, and may infect man. The same or similar species are found parasitic on the horse and on some birds, and may also affect man.

Trichophyton ochraceum Sabouraud 1909.

Type Ectothrix, of animal origin ; cultures somewhat similar to favus. On maltose and glucose agars the colonies are characterized by an ochre yellow knob ; portions of the growth may be covered by an extremely short, almost invisible, duvet. On ordinary agar the surface of the colonies is cerebriform. Optimum temperature, 25° C. It is easily inoculated into guinea-pigs.

Trichophyton album Sabouraud 1907.

The cultures are extremely like favus, but are generally less bulging, more deeply umbilicated, and more regularly folded ; the growth deepens in the medium ; some white duvet present. Optimum temperature, 25° C. Can be inoculated into guinea-pigs.

Trichophyton discoides Sabouraud 1909.

Endo-ectothrix, megalosporon, faviform. Somewhat similar to *T. album*, but the growth, which is almost a perfect disc, has a more flattened surface. There is often a central knob. The whole growth has a brownish-yellowish colour, with a moist surface, somewhat resembling the non-pigmented cultures of *T. violaceum*.

Trichophyton equinum Gedoelst 1902.

Endo-ectothrix, megalosporon, downy-culture type. Mycelial spores of oval shape, 4 to 6 μ in length, 2 to 4 μ in breadth. On maltose agar the growth is orbicular, with abundant duvet ; later on, the portion of the growth which is in contact with the medium becomes yellowish and afterwards dark red. It is parasitic in the horse, and may infect man.

Trichophyton megnini R. Blanchard 1895.

Synonyms.—*Trichophyton roseum* Bodin 1902, *T. rosaceum* Sabouraud 1902.

Endo-ectothrix, megalosporon, downy-culture type. Mycelial spores found in the hairs are very large, 8 to 9 μ in diameter. On maltose agar the growth is at first white, with a velvety appearance, later, pinkish, or of a deep rose colour. Duvet becomes very abundant in old cultures. It is parasitic in fowls and pigeons; may infect man, causing a variety of tinea barbæ without suppuration.

Trichophyton vinosum Sabouraud 1909.

Endo-ectothrix, megalosporon, of downy-culture type. Is very similar to *T. megnini*, but the colour of old cultures is of a deep wine-red colour. Abundant duvet. Found by Sabouraud in a case of tinea circinata.

Trichophyton nodoformans Castellani 1912.

Found in Ceylon in cases of dhobi itch and tinea barbæ; not very abundant in the lesions. On Sabouraud's agar the growth is white, with a powdery surface and a central small knob. The growth deepens in the medium, and the submerged portion has a characteristic brick-red colour, which generally disappears after repeated transplantations. The surface growth is whitish.

Glucose Agar.—Growth somewhat more abundant than in Sabouraud's agar. Colour of the surface and submerged growth white. Red pigment usually absent.

Maltose 4 per cent.—Scanty growth, no pigment.

Glycerine Agar.—Growth fairly abundant, no pigment.

Agar.—Scanty growth, whitish.

Saccharine.—Same as agar.

Adonite.—Same as agar.

Pathogenicity.—The fungus gives rise to a peculiar type of tinea cruris, with very thick, elevated margins and deep-seated nodules. It has pyogenic properties, and may spread to other parts of the body, in addition to the inguinal regions. It is capable of affecting the hair follicles. In one of our cases the fungus affected the hairs of the beard, producing a typical 'kerion barbæ.'

III. *Trichophytons not affecting the Hairs.*

Trichophyton albiscicans Nieuwenhuis 1907.

Discovered by Nieuwenhuis in tinea albigena. In fresh preparations from scrapings spores are absent; the mycelial tubes are straight, occasionally showing a double contour; they are often dichotomous. On Sabouraud's agar the growth is very slow, whitish, with a powdery surface.

Trichophyton blanchardi Castellani 1905.

Synonym.—*Trichophyton sabouraudi* Castellani 1905.

Temporary species, as the fungus has not been grown. In fresh preparations from the lesions the mycelial tubes are not, as a rule, quite straight; they are often banana-shaped; do not show a double contour; the mycelial segments are separated, the mycelial spores are shed without forming a filament by their union, and are of various sizes. All attempts at cultivation have failed. It is the cause of tinea Sabouraudi tropicalis.

Trichophyton ceylonense Castellani 1908.

Found by Castellani in cases of tinea nigro circinata. Temporary species, cultivation having not been obtained; possibly a variety of *T. blanchardi*. In fresh preparations the spores are very few in number, roundish, rather large (4 μ), showing a double contour. The mycelial tubes are about $3\frac{1}{2}$ μ in breadth, straight, or variously bent. It is found in tinea nigro circinata.

Trichophyton macfadyeni Castellani 1905.

Found by Castellani in some cases of tropical tinea corporis. In fresh preparations mycelium and spores are rather of small dimensions. The mycelial tubes are regularly shaped, do not show swellings, and are about $2\frac{1}{2}$ μ in breadth. The free spores are very numerous, and present a peculiar ovoid shape, the maximum diameter being $2\frac{1}{2}$ to $3\frac{1}{2}$ μ. In stained preparations the spores present a bipolar staining. The fungus grows with difficulty; on the rare occasions when the inoculations are successful, the growth is very slow, the colonies coalesce, forming a brownish mass, with deep furrows, and deeply rooted in the medium.

FIG. 382.—TRICHOPHYTON MACFADYENI CASTELLANI.
(Stained with fuchsin.)

Genus Epidermophyton Lang 1879 emend. Sabouraud 1907.

The fungi belonging to this genus, which has been thoroughly investigated by Sabouraud, grow superficially on the skin without invading the hairs and hair follicles; do not produce suppuration. Reproduction takes place principally by pluriseptate spindles, with, on the average, four to six cells. The septa, as noted by Pinoy, may not be complete, and the cavities may communicate. Spiral hyphæ, as found in most species of *Trichophyton*, absent; pectinate structures, as found in the *Microsporons*, absent; no spore-bearing hyphæ, with lateral conidia of type *Acladium*, as noted both in

the *Trichophytons* and in the *Microsporons*. The cultures undergo rapid degenerative changes, losing their characteristics, and becoming covered with abundant uniform, long, whitish duvet (pleomorphism). They are not inoculable into guinea-pigs, except Pinoy's *Epidermophyton simii*. The species so far known have been isolated from human lesions, except the *Epidermophyton* discovered by Pinoy in monkeys.

TABLE OF EPIDERMOPHYTONS.

Genus.	Species.
Epidermophyton Lang 1879, em. Sabouraud 1907	E. cruris Castellani 1905. E. perneti Castellani 1907. E. rubrum Castellani 1907. E. simii Pinoy 1911. E. repens Ekland 1883 (doubtful species).

Epidermophyton cruris Castellani 1905.

Synonyms.—*Trichophyton cruris* Castellani 1905, *Epidermophyton inguinalis* Sabouraud 1907, *T. castellanii* Brooke 1908.

Found in cases of tinea cruris in Ceylon by Castellani, and in France by Sabouraud. The fungus is very abundant in recent cases, extremely scarce in old ones. The mycelial tubes in recent cases are generally straight, have often a double contour, and the segments are somewhat rectangular, their breadth being $3\frac{1}{2}$ to $4\frac{1}{2}$ μ. Branching is not rare. The spores are rather large (4 to 7 μ), roundish, and have generally a double contour ; they do not collect in clusters. In chronic cases degeneration forms of the fungus are met with ; the mycelium may be banana-shaped, may show several constrictions, or long strings of ovoid elements may be seen.

This *Epidermophyton* grows well, but rather slowly, on Sabouraud's agar. The growth begins to be visible after four to eight days, the colonies being at first of a peculiar yellow colour, lemon-yellowish or orange-yellowish, occasionally with a greenish tinge. Later they become white, with pulverulent surface, and may be acuminate or crateriform. Pleomorphism, with abundant white duvet, develops quickly.

This fungus in Ceylon is the commonest species found in cases of tinea cruris. It is not inoculable into guinea-pigs. Attempts at reproducing the eruption in man by inoculating pure cultures have also failed.

Epidermophyton perneti Castellani 1907.

This fungus has been described by Pernet. It differs from *E. cruris* by growing much more rapidly on Sabouraud's agar and by the cultures having a delicate pinkish colour, which is generally lost in subcultures. It is very rare in Ceylon.

Epidermophyton rubrum Castellani 1909.

Synonym.—*Trichophyton purpureum* Bang 1910.

This fungus was described by Castellani in Ceylon in 1909 and by Bang in France in 1910. On Sabouraud's agar the growth begins to appear four to six days after inoculation as a raised red spot, which gradually enlarges. At complete development the growth is of a deep red colour, either with a central knob or crateriform, and is partly covered with a white, delicate duvet. In old cultures the white duvet is much more abundant and thicker, and may hide the red pigmentation almost completely.

On *glucose agar* (4 per cent.), which is the best medium for this fungus, the growth is of a very deep blood-red colour, and the red pigmentation may spread to portions of the medium itself. In old cultures abundant white—occasionally white-greenish—duvet is present. This may hide the pigmentation, but, scraping out the duvet, the red pigmentation will be found to be still well-marked. On ordinary agar and glycerine agar the fungus grows fairly well, but there is no red pigmentation.

Epidermophyton simii Pinoy 1911.

Discovered by Pinoy in a trichophytic-like eruption observed in a monkey. Completely described by the same author. On Sabouraud's agar the growth is at first yellowish-orange, somewhat similar to *E. cruris ;* later, the growth is whitish and covered with white duvet.

Pinoy's fungus has several interesting botanical features, some of which are those of the genera *Microsporon* and *Trichophyton*. In contrast to the typical *Epidermophytons*, it presents spore-bearing hyphæ with lateral conidia, and is inoculable into guinea-pigs, in which it produces a trichophytic-like eruption.

Epidermophyton repens Eklund 1883.

Very doubtful species, found by Eklund in cases of psoriasis. It is not the ætiological agent of the disease.

Genus Achorion Remak 1845.

The fungi belonging to this genus often show during parasitic life much longer mycelial segments than *Trichophytons* and *Microsporons ;* masses of them, developing in hair follicles, form the well-known sulphur-coloured *scutula* which always develop round a hair. In the hairs the mycelial tubes are frequently trichotomous and tetrachotomous, forming structures which have been compared in appearance to the skeleton of the human foot, and called 'favus tarsi.'

Cultures.—Sabouraud has noted that in hanging-drop cultures the spores sometimes develop very slowly, sometimes rapidly. When the development is slow, there is formation of numerous

chlamydospores of various sizes, with a double contour membrane. When the development is rapid, one notes that the mycelium ramifies quickly in every direction, with presence of very few or no chlamydospores. The following structures may be noted :

1. *Claviform Bodies.*—The terminal portion of some filaments becomes swollen and claviform. These claviform filaments have been compared by some authorities to the ' spindles ' of the *Trichophytons* and *Microsporons*, but they are slenderer, and not septate. The French authors call these formations ' chandeliers faviques,' on account of their shape somewhat resembling a candlestick.

2. *Favus Yellow Bodies.*—The protoplasm of some filaments collects itself at the terminal ends, the filaments becoming much thinner, and terminating in roundish or oval bodies, which must be considered to be terminal chlamydospores. It is to be noted that in the typical *Achorions* of human origin conidia-bearing hyphæ are not seen, while these are present in the *Achorions* of animal origin, in which separate spindles may also be present.

Media.—*Achorions* grow well on all the usual sugar media, especially Sabouraud's agar and glucose agar. They generally liquefy gelatine fairly rapidly.

Pleomorphism.—Very common in all *Achorions*. If a culture becomes pleomorphic, it is impossible to make it revert to the original characters.

Transmission.—In the case of achorions of human origin infection takes place from man to man ; in the case of *Achorions* of animal origin infection takes place from the lower animals. It is not impossible that *Achorions* may live saprophytically in nature.

TABLE OF ACHORIONS.

Genus.		Species.
Achorion Remak 1845	Of human origin (typical)	A. schoenleini Lebert 1845.
	Of animal origin (non-typical)	A. quinckeanum Zopf 1890.
		A. gypseum Bodin 1907.
		A. arloingi Blanchard 1891.

Achorion schoenleini Lebert 1845.

Synonyms.—*Oidium schoenleini* Lebert 1845, *O. porriginis* Montague, *Oospora porriginis* Saccardo 1886, *Oidium schoenleini* Zopf 1890.

Causes the well-known affection called *favus*, which is characterized by the presence of peculiar disc-shaped crust formations, called *scutula*, of a sulphur-yellow colour, and emitting an offensive odour compared to the smell of mice's urine.

The fungus may infect the hairs or glabrous parts of the body ; it may attack the nails. In the hairs the mycelium is very abundant, the segments being comparatively long. Sometimes the mycelial threads divide into three or four branches, each of which

terminates in a single row of roundish spores. This is known as *favic tarsus*.

Cultures.—The fungus is easily cultivated on various media. On Sabouraud's agar and on glucose agar the growth, when completely developed, is convoluted or cerebriform, and somewhat bulging. It has been compared by Sabouraud to the appearance of a sponge. The colour is white-yellowish, like that of old wax. After a time cultures become pleomorphic and abundant; white duvet is present. To prevent pleomorphism, media not containing sugars should be used (see p. 822).

A. schoenleini liquefies gelatine in between three to four days, while the *Trichophytons* take generally between fifteen to twenty days.

By inoculation of pure cultures of the fungus favus lesions are produced in man, dogs, mice, rabbits and fowls. The inoculation in guinea-pigs does not give rise to typical favus lesions with scutula, but to circinate trichophytic-like lesions.

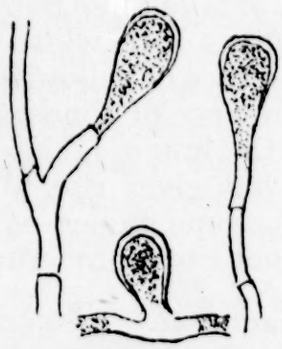

FIG. 383.—SO-CALLED YELLOW BODIES IN CULTURES OF ACHORION SCHOENLEINI LEBERT. (After Bodin.)

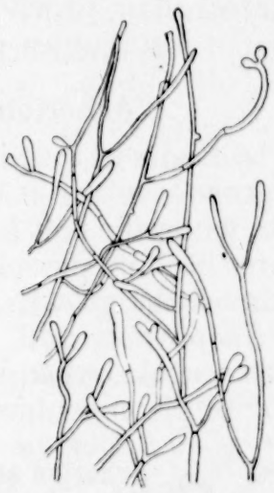

FIG. 384.—CLAVIFORM BODIES IN CULTURES OF ACHORION SCHOENLEINI LEBERT.

Reproduction.—This takes place—

1. By sprouting.

2. By elongated fusiform structures analogous, according to some authorities, to the so-called 'spindles' of the *Trichophytons* and *Microsporons*, but they are slenderer and not septate. These formations are called by the French authors 'chandeliers faviques,' on account of their shape somewhat resembling a candlestick.

3. By so-called 'favus' or 'yellow bodies,' which are structures 8 to 15 μ in diameter, generally terminal, showing a double contour, and containing a granular substance. These structures should probably be considered to be chlamydospores (see also general remarks on the genus *Achorion*).

Sabouraud admits only one species of human *Achorion*, but

Neeb and Unna have described as many as nine: *Achorion cysticum, A. tarsiferon, A. moniliforme, A. demergens, A. akromegalicum, A. dikroon, A. radians, A. euthythrix, A. atacton.* Sabouraud's opinion is the one generally accepted at the present time.

Achorion quinckeanum Zopf 1890.

The fungus appears in the lesions in the shape of numerous mycelial filaments associated in so many small segments constituting the spores. Grows readily on Sabouraud's agar, producing white, downy colonies.

This fungus botanically holds an intermediate position between the typical *Achorions* and the *Microsporons* and *Trichophytons*, conidia bearing hyphæ of the type *Acladium* being present. It produces, however, typical favus lesions with scutula.

Pathogenicity.—Is the cause of favus in mice, and may occasionally infect man, in whom, too, it induces typical favus. It can be inoculated into guinea-pigs.

Achorion gypseum Bodin 1907.

Found by Bodin in 1907 in a typical case of favus. On Sabouraud's agar the growth, which is roundish, presents a little white duvet in the centre, while the rest has a glabrous surface of yellowish colour. Old cultures become pleomorphic, with presence of abundant white duvet all over the growth. Botanically the fungus is closely allied to the *Trichophytons* and *Microsporons*, but gives rise to typical favus, with scutula, when inoculated in mice and guinea-pigs. The inoculation of pleomorphic cultures does not cause any eruption.

Achorion arloingi R. Blanchard 1891.

Synonym.—*Achorion arloingi* Busquet 1891.

Incompletely known species. Was isolated from a human trichophytic-like eruption by Désir de Fortunet and Courmont. Is said to be inoculable into mice, rabbits, and man.

Genus Lophophyton Matruchot and Dassouville 1899.

Mycelial filaments, either tortuous, very thin, or thick, with granular protoplasm. No spores present. One species only.

Lophophyton gallinæ Mégnin 1881.

Synonyms.—*Epidermophyton gallinæ* Mégnin 1881 *Lophophyton gallinæ* Matruchot and Dassouville 1899, *Achorion gallinæ* Sabouraud 1910.

In the lesions mycelial filaments are seen, some thin and tortuous, without practically any protoplasm; others of much larger dimensions, with granular protoplasm. No spores observed. The fungus is easily cultivated, and is inoculable into rabbits, mice, and fowls, in which it gives rise to typical favus lesions. In man it does not produce favus, but merely trichophytic-like erythematous, squamous patches.

Genus Endodermophyton Castellani 1909.

The fungi belonging to this genus are characterized by their growing between the superficial and deep strata of the epidermis

forming an interlacing felt of mycelia, which detaches the horny and granular layers from the rete Malpighi. They do not invade the hair follicles, and do not cause suppuration. They have been cultivated by Castellani.

Cultures.—Botanically, these fungi are closely allied to the *Achorions*, as remarked by Sabouraud and Pinoy, who have examined Castellani's cultures. Attempts at cultivation failed for a long time, as they generally do not grow on solid media direct from the scales. These, after being treated with alcohol for five to ten minutes, must be placed in glucose-broth tubes, one scale in each tube. Most of the tubes become contaminated with bacteria, but in those which remain clear, after a time (five to ten days) a few delicate, short, white filaments will be seen originating from the scale. The growth slowly increases until, after three to four weeks, it takes the appearance of a small, white, fluffy mass, with a dark spot (the scale) in the centre. Portions of the broth cultures are sown on solid sugar media, on which growth takes place now quite easily. Fungi can then be indefinitely subcultured on solid media. The fungi grow much more abundantly on glucose agar, 4 per cent., than on Sabouraud or any other media.

Reproduction.—In hanging-drop cultures long mycelial filaments are seen ; no conidia-bearing hyphæ are present ; reproduction is apparently by sprouting, branching taking place ; but further investigation is necessary on the subject.

Pleomorphism.—Pleomorphism is much less marked than in the *Trichophytons*, *Epidermophytons*, and *Achorions*. Old cultures, however, may lose their characteristics, becoming covered with duvet.

TABLE SHOWING ENDODERMOPHYTONS FOUND IN MAN.

Genus.	Species.
Endodermophyton Castellani 1909 ..	E. concentricum Blanchard 1901. E. indicum Castellani 1911. E. castellanii Perry 1907.

Endodermophyton concentricum Blanchard.

Remarks.—Manson, in 1872, described a trichophyton-like organism in the squamæ of *tinea imbricata ;* with the laboratory technique of that time attempts at cultivation did not succeed. Blanchard considered it non-cultivable, and called it *Trichophyton concentricum ;* on the other hand, Nieuwenhuis stated that it was quite easily cultivable, and was characterized by the colonies being crateriform. His researches were not confirmed. In recent years the general opinion has been that aspergillus-like fungi were the real cause of the disease. Tribondeau described fructifications somewhat similar to those of an *Aspergillus*, and created for the fungus the genus *Lepidophyton*. Wehmer has described it as a true *Aspergillus*—*Aspergillus tokelau*. Castellani, from the investigations he has carried out in Ceylon, has come to the conclusion that *Aspergillus* and aspergillus-like fungi have nothing to do with the

disease. When they are present in the squamæ, they are merely saprophytes or contaminations. By using a special technique he has succeeded in growing what he considers to be the true fungi causing the disease ; he has isolated two species, and suggests that the specific term *concentricum* should be retained for one of them.

Endodermophyton concentricum is very abundant in the lesions, forming a felting of interlacing mycelial threads with mycelial articles, regular in shape, rectangular or somewhat square-shaped,

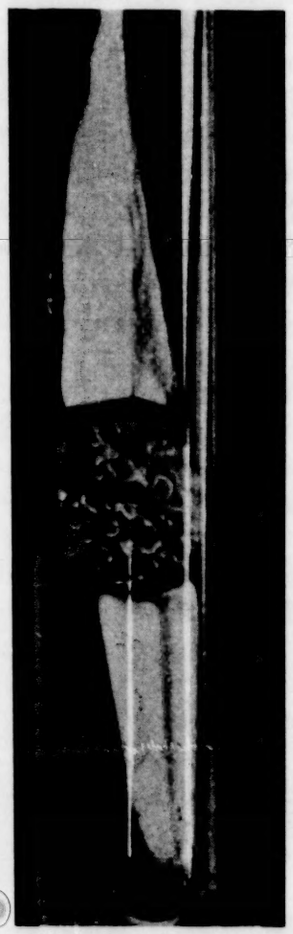

FIG. 385.—ENDODERMOPHYTON CONCENTRICUM BLANCHARD : GLUCOSE-AGAR CULTURE.

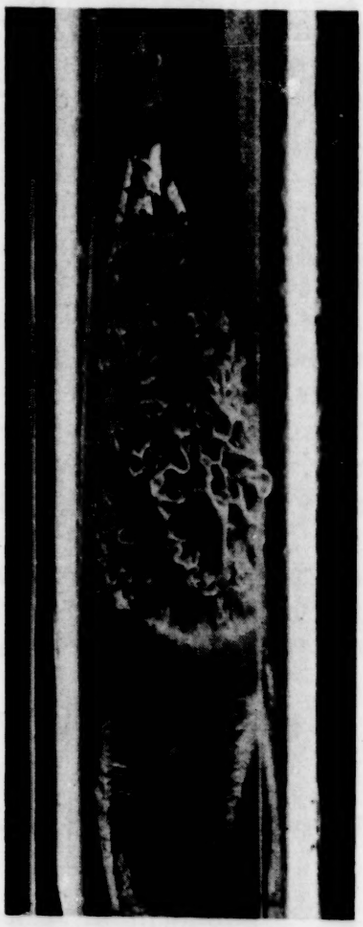

FIG. 386.—ENDODERMOPHYTON CONCENTRICUM BLANCHARD : OLD GLUCOSE-AGAR CULTURE.

and usually straight. If the liquor potassæ be left to act some time, the mycelial articles, which are of very variable length, and $2\frac{1}{2}$ to $3\frac{1}{2}$ μ in breadth, will be seen to have a double contour. *Aspergillus fructifications*, described by so many authors, when present, are due to contaminations ; they form no part of the fungus. Cultivation of this fungus has been obtained by Castellani, using the method mentioned in the paragraph above on the genus *Endodermophyton*.

The principal cultural characters on solid media, when the growth is fifteen to twenty-one days old, are as follow :—

Glucose Agar (4 *per cent.*).—Growth abundant ; surface cerebriform or crinkled. The growth and the medium show a slight amber colour, which later on may become of much deeper hue. Duvet as a rule absent, but in

old cultures which have been transplanted many times and are degenerating, some very scarce, short, whitish duvet may appear.

Sabouraud Agar.—Growth comparatively scanty, whitish-grey, mostly submerged. The colonies are whitish, have generally a small central knob, and never show any duvet. The submerged portion is very firmly embedded, and often presents projections deepening in the medium. Colour of the medium unchanged.

Glycerine Agar.—Similar growth to Sabouraud's agar. When the colonies coalesce, the growth shows a knobby surface. No duvet.

Ordinary Agar.—Scanty growth, somewhat similar to Sabouraud. No duvet.

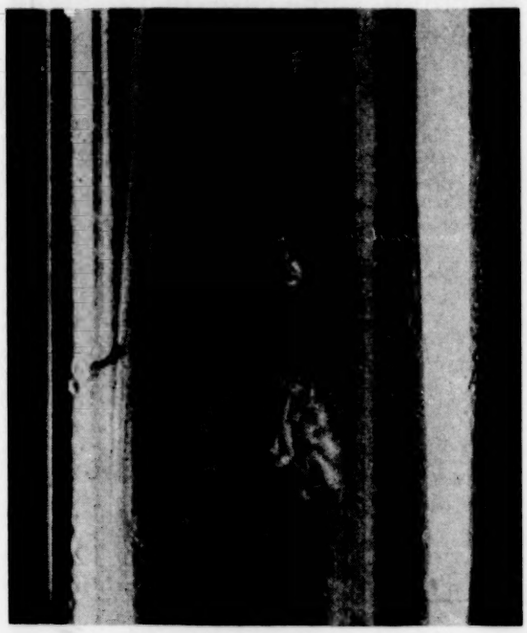

FIG. 387.—ENDODERMOPHYTON CONCENTRICUM BLANCHARD: AGAR CULTURE.

FIG. 388. — ENDODERMOPHYTON CONCENTRICUM BLANCHARD: MALTOSE-AGAR CULTURE.

Mannite Agar (4 *per cent.*).—Appearance somewhat similar to glucose, but growth less abundant. The medium may take a slight amber colour. No duvet.

Saccharose Agar (4 *per cent.*).—Growth rather scanty, similar to Sabouraud. Duvet absent.

Nutrose Agar (4 *per cent.*).—Very slow growth. Separate young colonies have a central knob; they coalesce later into a knobby mass.

Maltose Agar (*Acid*).—Similar to Sabouraud.

Maltose Agar (*Alkaline*).—Similar to Sabouraud.

Adonite Agar.—Not very abundant; cerebriform; duvet absent.

Galactose Agar.—Knobby or cerebriform.

Lævulose Agar.—Knobby.

Raffinose Agar.—Cerebriform.

Inuline Agar.—Cerebriform.

Saccharine Agar (4 *per. cent.*).—Somewhat knobby surface; duvet absent.

Lactose Agar.—Similar to Sabouraud, but surface growth more abundant.

Gelatine.—Very slow liquefaction of the medium.

Milk.—Very scanty growth. After a time the medium becomes separated.

Sugar Broths (*Maltose, Lactose, etc.*).—Slight growth at the bottom of the tube; no production of acid or gas.

Hanging-Drop Cultures.—In hanging-drop cultures (Sabouraud's broth) long mycelial threads are seen. Reproduction is apparently by sprouts from the mycelium, branching taking place.

Pathogenicity.—The fungus is the cause of a common type of tinea imbricata. Castellani has demonstrated that the inoculations into human beings of cultures of the fungus reproduce a typical form of tinea imbricata, and that from the scales of the eruption, experimentally induced, the same fungus is recoverable. For further details see Chapter LXIII. on Tinea Imbricata.

Endodermophyton indicum Castellani 1911.

This fungus was found by Castellani in some cases of *Tinea imbricata*. The microscopical appearance of the fungus in the scales is

FIG. 389.—PATCH OF EXPERIMENTAL TINEA IMBRICATA IN A SINGHALESE BOY, OBTAINED BY INOCULATING A CULTURE OF ENDODERMOPHYTON INDICUM.

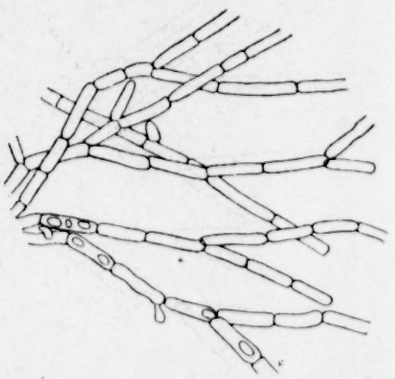

FIG. 390.—ENDODERMOPHYTON INDICUM CASTELLANI: HANGING-DROP CULTURE.

identical with *E. concentricum*. The principal cultural characters on solid media, when the growth takes place in the dark, about 80° to 85° F., without rubber caps on the tubes, and is between fifteen and twenty-one days old, are as follow:—

Glucose Agar (*4 per cent.*).—Growth fairly abundant, with surface somewhat convoluted or furrowed. Portions of the growth, often the central, is of a deep orange, or pinkish-orange, or red-orange, occasionally of bright red colour. The surface of the rest of the growth often appears white and powdery, being covered by a very short delicate white duvet.

Sabouraud Agar.—Slow growth, with powdery surface, either with central knob, or convoluted. The growth does not deepen in the medium so much as *E. concentricum*.

Glycerine Agar.—Growth abundant, white or amber colour; delicate white short duvet present on some portions of the growth.

Ordinary Agar.—Growth fairly abundant; knobby surface covered by snow-white very short delicate duvet.

Mannite Agar.—Growth knobby or convoluted, covered by short white duvet.

Saccharose Agar.—Cerebriform, covered by white duvet.

Saccharine.—Crinkled surface; delicate white duvet present.

Maltose Agar (*Acid*).—Somewhat similar to Sabouraud's, but the surface growth is more abundant.

Maltose Agar (*Alkaline*).—Similar to acid maltose, but the white duvet is more abundant.

Lactose Agar.—Knobby surface covered by snow-white duvet.

Nutrose Agar.—Yellowish crinkled surface; short white duvet present.

Lævulose Agar.—Scanty growth, yellow or orange ; scarce ; very short white duvet present.

Galactose Agar.—Fairly abundant ; surface convoluted with abundant, short snow-white duvet.

Raffinose Agar.—Same appearance as galactose.

Inuline Agar.—Same appearance as in galactose and raffinose agars.

Adonite Agar.—Cerebriform ; surface covered with snow-white duvet.

Gelatine.—Very slow liquefaction.

Lit. Milk.—Very scanty growth. After a time the medium may become separated.

Various Sugar Broths (*Maltose, Lactose, etc.*).—Slight growth at the bottom of the tube. No production of acid or gas.

The annexed table shows at a glance the different cultural characteristics of the two fungi in the principal media.

COMPARISON BETWEEN THE CULTURAL CHARACTERS OF ENDODERMOPHYTON CONCENTRICUM AND OF ENDODERMOPHYTON INDICUM.

Media.	E. concentricum.	E. indicum.
Glucose agar . .	Amber colour, duvet absent in young cultures.	Deep orange, at times pinkish or red, very short white delicate duvet often present.
Sabouraud-agar	Growth scanty, mostly submerged, grey-whitish duvet absent.	Surface growth more abundant, powdery white.
Agar	Scanty, mostly submerged ; similar to Sabouraud agar ; no duvet.	Fairly abundant, knobby, well-marked snow-white duvet.
Glycerine agar	Growth mostly submerged ; surface growth very scanty ; similar to Sabouraud agar ; no duvet.	Surface growth very abundant ; crinkled appearance ; white short duvet present.

The above characters are based upon the appearance of cultures kept in the dark at a temperature 80° to 90° F., and without rubber caps. If any of these conditions are altered, the cultural characters are changed. If rubber caps are used, both *E. indicum* and *E. concentricum* may assume a bright red colour. If, however, subcultures are made from these, using tubes without rubber caps, the fungi again show the characters given above.

Hanging-Drop Cultures.—Long mycelial filaments are present. No free spores are seen ; reproduction is apparently by sprouts from the mycelium.

Pathogenicity.—The fungus is the cause of a certain number of cases of tinea imbricata. The type of the disease caused by this fungus seems to be more superficial than that caused by *T. concentricum*, but further researches are required on this subject. Castellani has succeeded in experimentally reproducing the disease by inoculating coolies, who had volunteered, with pure cultures of the fungus. The skin was first scarified with a sterile knife ; then a certain amount of a pure agar culture of *E. indicum* was well rubbed in. After fifteen to twenty-one days the first signs of the eruption

appeared, and the typical patches of tinea imbricata developed. From the scales of the experimental cases a fungus was grown absolutely identical with the strain of *E. indicum* with which the individuals had been inoculated.

FIG. 391.—ENDODERMOPHYTON INDICUM CASTELLANI: AGAR CULTURE.

FIG. 392.—ENDODERMOPHYTON INDICUM CASTELLANI: GLUCOSE AGAR CULTURE.

FIG. 393.—ENDODERMOPHYTON INDICUM CASTELLANI IN THE SCALES.

Endodermophyton castellanii Perry 1907.

Found by Castellani in cases of *Tinea Intersecta*. In the scales the mycelium is fairly abundant; no free spores are seen. Mycelial segments uniform, rather straight, and, provided the liquor potassæ be left to act for sufficient time, they often show a double contour. Their breadth is $2\frac{1}{2}$ to $3\frac{1}{2}$ μ. Each mycelial

segment has two roundish refringent dots, one at each extremity. Has been cultivated only on one occasion, the cultures being extremely similar to those of *E. indicum*. It is the cause of tinea intersecta.

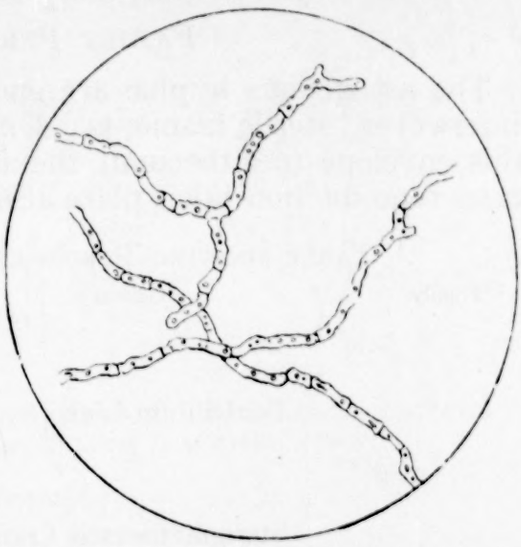

FIG. 394.—ENDODERMOPHYTON CASTELLANII PERRY.

Genus Oospora Wallroth 1883.

Mycelium slender, septate; differentiated nuclei present; some mycelial threads abstrict at their extremities chains of spores.

Oospora canina Costantin-Sabrazès 1893.

Synonym.—*Mycoderma caninum* Verdun 1912.

Causes the favus of dogs; may be transmitted to man, but seldom gives rise to typical lesions, the eruption as a rule resembling ringworm. In the lesions oval or roundish bodies, 5 to 6 μ in diameter, are seen, and thin mycelial filaments. The fungus is easily cultivated on Sabouraud's agar. The growth is of a red colour, and after a time becomes covered with abundant white duvet. It is inoculable into dogs and mice, in which it induces typical favus. The only mode of reproduction so far known is by chains of conidia.

Genus Montoyella Castellani 1907.

Temporary genus. Two kinds of mycelial threads: some slender, ramified, septate; others much thicker, having numerous intermediate chlamydospores. From the thicker filaments delicate hyphæ take origin, which terminate in large pear-shaped or globular conidia.

Montoyella nigra Castellani 1907.

Temporary species. Colonies on maltose agar are black. If glycerine agar is used, the medium takes a black colour. This species, discovered by Montoya, is common in black pinta.

Montoyella bodini Castellani 1907.

Temporary species. Colonies whitish or greenish.

SUBORDER CARPOASCEES.

This suborder of Ascomycetes is characterized by the fact that the *asci* are not free, and do not take origin directly from the mycelium. They are produced in special fructifications.

Of the suborder Carpoascees, only two families, the *Perisporiaceæ* and the *Pyrenomycetes*, contain species parasitic on man.

Family Perisporiaceæ.

The ascogenous hyphæ are enclosed by a compact envelope of interwoven, sterile filaments. On the rupture or disintegration of this envelope (perithecium) the ascospores become free. In many cases reproduction takes place also by means of conidia.

Table showing Perisporiaceæ Parasitic in Man.

Family.	Genus.	Species.
Perisporiaceæ	Penicillium Link 1809	P. crustaceum Linnæus 1763. P. minimum Siebenmann 1889. P. barbæ Castellani 1907. P. montoyai Castellani 1907. P. pruriosum Salisbury. P. brevicaule var. hominis Brumpt and Langeron 1910.
	Sterigmatocystis Cramer 1869	S. nigra von Tieghem 1867. S. nidulans Eidam 1883.
	Aspergillus Micheli 1725	A. fumigatus Fresenius 1775. A. flavus De Bary 1870. A. bronchialis Blumentritt 1901. A. nigrescens Robin 1889. A. repens De Bary 1870. A. malignus Lindt 1889. A. pictor R. Blanchard 1895. A. barbæ Castellani 1907. A. bouffardi Brumpt 1905. A. herbariorum Wiggers 1780. A. fontoynonti Guéguen 1909.
	Madurella Brumpt 1905 (temporary)	M. mycetomi Laveran 1902. M. tozeuri Ch. Nicolle and Pinoy 1908. M. bovoi Brumpt 1910.
	Indiella Brumpt 1906 (temporary)	I. mansoni Brumpt 1906. I. reynieri Brumpt 1906. I. somaliensis Brumpt 1906.

Genus **Penicillium** Link 1809.

The whole fruit-bearing hypha with its sterigmata and conidia resembles a hair-pencil, hence the name of the genus (*Penicillium* = hair-pencil). The conidiophore hypha shows verticillate branches, which give rise to slender fusiform formations (sterigmata) abstricting chains of conidia.

Penicillium crustaceum Linnæus 1763.

Synonyms.—*Mucor crustaceus albus* Linnæus 1763, *Monilia digitata* Persoon, *Penicillium glaucum* Linnæus 1809, *P. expansum* Linnæus, *P. crustaceum* Fries 1829.

An extremely common saprophyte found on bread, cheese, fruits, and various organic substances in a state of decomposition. The

conidia are spherical or slightly elliptical, of bronze colour, with smooth surface ; maximum diameter 4 μ. This fungus grows well at any temperature between 2° and 35° C., and is very resistant.

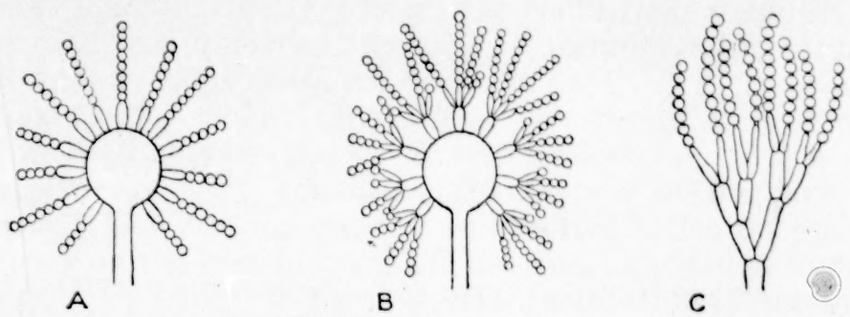

FIG. 395.—A, ASPERGILLUS FRUCTIFICATION ; B, STERIGMATOCYSTIS FRUCTIFICATION ; C, PENICILLIUM FRUCTIFICATION.

(After Brumpt.)

It has been found by Maggiora and Gradenigo in two cases of otitis media. Heinhorn has observed it in the vomiting of four cases of acid dyspepsia together with *Aspergillus herbariorum*.

Wertheim has observed that the intravenous inoculation of *P. crustaceum* is pathogenic to rabbits, dogs, and lambs.

Penicillium minimum Siebenmann 1889.

Conidia are roundish, smooth, of a brownish-black colour ; smaller than in *P. crustaceum* being 2·5 to 3 μ in diameter. Was found in a case of acute otitis by Siebenmann.

Penicillium montoyai Castellani 1907.

Synonym.—*P. pictor* Neveu-Lemaire 1908.

Conidia roundish or slightly oval, smooth, 3 to 4½ μ in diameter. Grows well on maltose agar and ordinary agar ; cultures of dark greyish colour. Discovered by Montoya in cases of pinta, of the greyish-violet variety. Similar species, not yet well defined, are found in other varieties of pinta.

Penicillium brevicaule var. hominis Brumpt and Langeron 1910.

Found by Brumpt and Langeron in two cases of onychomycosis. In the lesions septate mycelial threads were seen, 2 to 10 μ in diameter, and large groups of chlamydospores, generally terminal, 10 to 30 μ in diameter. The fungus is easily cultivated on Sabouraud's agar and other sugar media, also on potatoes and carrots.

Optimum temperature 25° C., but grows well also at 37° C. Conidia spherical or occasionally ovoid, of a chocolate colour.

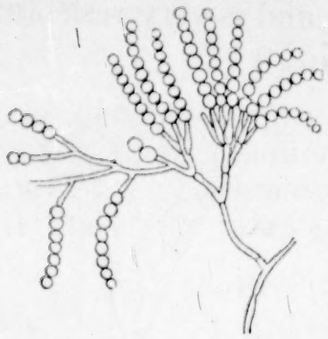

FIG. 396.—PENICILLIUM BREVICAULE VAR. HOMINIS. BRUMPT AND LANGERON. (After Brumpt.)

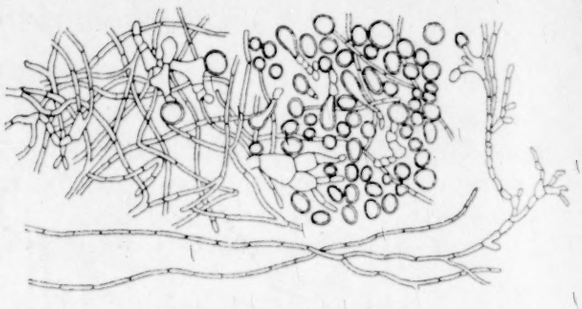

FIG. 397.—PENICILLIUM BREVICAULE VAR. HOMINIS BRUMPT AND LANGERON. (Preparation from the diseased nails, after Brumpt.)

Penicillium barbæ Castellani 1907.

Found by us growing on the beard of natives of equatorial Africa, and in natives of Ceylon.

Penicillium pruriosum Salisbury.

Doubtful species found by Salisbury in the vaginal mucus of a woman suffering from intense vaginal pruritus.

Genus Aspergillus Micheli 1725.

The conidiophore hyphæ are not ramified, and terminate into ovoid or roundish formations, which support numerous claviform elements (sterigmata), each of which supports a chain of roundish conidia.

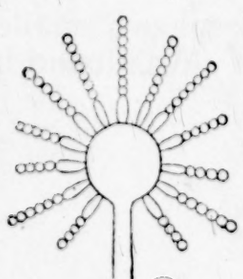

FIG. 398.—ASPERGILLUS FRUCTIFICATION. (After Brumpt.)

Aspergilli are generally saprophytes, but they may become parasites. They are easily grown on acid media, liquid or solid, and also on alkaline media. Iron and manganese have a favourable influence on the growth and sporulation of these fungi.

A medium much used is Raulin's liquid, the formula of which is: Cane-sugar, 70 grammes; tartaric acid, 4 grammes; ammonium nitrate, 4 grammes; ammonium phosphate, 0·60 gramme; potassium carbonate, 0·60 gramme; magnesium carbonate, 0·40 gramme; ammonium sulphate, 0·25 gramme; zinc sulphate, 0·07 gramme; ferrous sulphate, 0·07 gramme; potassium silicate, 0·07 gramme.

Fungi of the genus *Aspergillus*, when growing parasitically in the tissues, often lose their characteristics; the typical fructifications are absent, and only mycelial threads and roundish or oval yeast-like bodies are seen.

Aspergillus fumigatus Fresenius 1775.

This is the commonest *Aspergillus*, and is very often found on various cereals, straw, hay, etc. On solid media it produces a brownish-black culture if the medium is alkaline or neutral, greenish

if the medium is acid. The mycelial filaments are more or less ramified, the breadth varying between 2 and 3 μ. The conidiophore hyphæ are much thicker than the mycelial tubes, being, on the average, about 5 μ in breadth. The sterigmata, which are situated very close together, are 6 μ long; the conidia are roundish, 2·5 to 3 μ in diameter, smooth, colourless. Optimum temperature, 37° C.; the growth stops below 20° or above 55° C.

Pathogenicity.—This *Aspergillus* is the species most frequently found in man, giving rise to an aspergillosis of various organs. The spores are very resistant. Perchloride of mercury is the antiseptic which has the greatest destructive action on the spores. The effects on the human organism are due, in addition to mechanical action, to toxins secreted by the fungi. Lucet has found in cultures of *A. fumigatus* in Raulin's liquid a pyrogenic substance;

FIG. 399.—ASPERGILLUS FUMIGATUS FRESENIUS.

FIG. 400.—ASPERGILLUS BRONCHIALIS BLUMENTRITT. (After Blumentritt.)

Ceni and Besta have isolated toxic products soluble in ether and alcohol, which act on the muscular and nervous system of dogs and rabbits. (See also Remarks on Aspergillomycoses, p. 806.)

Aspergillus flavus De Bary 1870.

Synonyms.—*Monilia aurea* Gmelin 1791, *Eurotium flavum* De Bary 1870, *Aspergillus flavescens* Wreden 1874.

Mycelium colourless; conidiophore hyphæ terminate in roundish formations of a gold-yellow colour. The conidia are dark yellow, roundish, 5 to 7 μ in diameter, with a surface showing numerous minute mammillar prominences. Found by several observers (Wreden, Siebenmann, etc.) in the ear. Optimum temperature 37° C.

Aspergillus bronchialis Blumentritt 1901.

Mycelium of a white colour, much ramified; conidiophore hyphæ are 6·2 to 12·6 μ in diameter, 280 to 300 μ in length. Conidia

roundish, 3 to 4 μ in diameter, with a smooth surface, of a greyish-greenish colour. This *Aspergillus* was found by Chiari in the bronchi of a patient who had died from diabetes ; it was investigated by Blumentritt. It has not yet been found as a saprophyte.

Aspergillus fontoynonti Guéguen 1909.

Found by Fontoynont and Carougeau in a European living in Madagascar, who was suffering from multiple abscesses of the neck. In the pus and in the first cultures obtained the fungus had no true aspergillar appearance ; it had to be subcultured several times before the typical aspergillar fructifications appeared. Conidia 4 to 5 μ in diameter, with surface finely verrucose. Optimum temperature, 22° to 25° C.

Aspergillus malignus Lindt 1889.

Synonym.—*Eurotium malignum* Lindt 1889.

Colourless mycelium, composed of short articles. Conidiophore hyphæ erected, terminating in pyriform formations, 22 to 24 μ in

FIG. 401.—ASPERGILLUS MALIGNUS LINDT.
(After Lindt.)

FIG. 402.—ASPERGILLUS REPENS DE BARY.
(After Siebenmann.)

diameter, on which are situated the sterigmata, which are 10 μ long and 4 to 5 μ in breadth. Conidia roundish of a greenish-bluish colour.

Pathogenicity.—This *Aspergillus* was found by Lindt in a case of otomycosis ; according to this author, it is very pathogenic for rabbits.

Aspergillus herbariorum Wiggers 1780.

Synonym.—*Mucor herbariorum* Wiggers 1780, *Aspergillus glaucus* De Bary 1870.

Mycelium at first colourless, later yellow or reddish-yellow. This *Aspergillus* is characterized by the large size of the conidia, which are 9 to 15 μ in diameter. It is in nature a common saprophytic fungus. It has been found by Dunn in 1896 in the nasal cavities of a man, and by Einhorn in 1900 in the vomit of a case of hyperchloridia.

Aspergillus repens De Bary 1870.

Synonym.—*Eurotium repens* De Bary 1870.

This fungus is very similar to *A. herbariorum*, but for the smaller size of the conidia. Mycelium of a yellowish-green colour. Conidia large, 7 to 8·5 μ. Found by Siebenmann in the ear three times. Its pathogenic rôle is doubtful.

Quevedo has described an aspergillus very similar to *A. repens*, which he believes to be the cause of a type of encephalo-myelitis in horses in South America. He calls the organism *A. mayidis*.

Aspergillus pictor R. Blanchard 1895.

Synonym.—*Trichophyton pictor* R. Blanchard 1895.

The term *Aspergillus* (*Trichophyton*) *pictor*, introduced by Blanchard in 1895, before the plurality of species of the fungi found in pinta was demonstrated, is now used to denote the species of *Aspergillus* which is found in the pure violet variety of pinta. This fungus shows the typical morphological characters of the genus *Aspergillus*. It grows easily on various sugar media. On maltose agar the growth has at first a whitish colour, which afterwards changes into greenish, to become violet or greenish with a violet tinge at a later period. The colour of the growth may vary according to the medium on which cultivation takes place. The conidiophores are comparatively thick; the conidia are globular, with a smooth surface.

Several other species of aspergillar and aspergillar-like fungi are found in pinta, but their botanical position has not yet been defined with certainty.

FIG. 403. — ASPERGILLUS PICTOR R. BLANCHARD. (After Montoya y Florez.)

Aspergillus bouffardi Brumpt 1905.

Found by Bouffard in a case of black mycetoma, and completely described by Brumpt. Mycelium whitish in some zones, dark brown in others. Conidiophores erect, white, each terminating in a claviform structure, bearing some short chains of roundish conidia. Conidia 1·3 to 2 μ in diameter, roundish with a smooth surface, white. Chlamydospores present, 5 to 10 μ in diameter. Attempts at cultivation did not succeed.

Aspergillus barbæ Castellani 1907.

Found by us in natives of Uganda, and in natives of Ceylon. Conidia spherical, 4 to 5 μ, of a brownish colour.

Aspergillus nigrescens Robin 1889.

Doubtful species, which, according to Wienfeld, causes a faviform eruption.

Genus Sterigmatocystis Cramer 1869.

Conidiophores terminate in roundish or ovoid formations, on which are situated short cylindrical structures—*primary sterigmata*—surmounted by similar elements—*secondary sterigmata*. Each of the secondary sterigmata abstricts a chain of roundish conidia.

Sterigmatocystis nigra Cramer 1859.

Synonyms.—*Sterigmatocystis antacustica* Cramer 1869, *Eurotium nigrum* De Bary 1870, *Monilia pulla* Persoon, *Aspergillus nigricans* Wreden 1874, *A. niger* von Tieghem 1867.

Primary and secondary sterigmata; erected conidiophores; hyphæ more than 1 millimetre in length (3·5 to 4·5). Conidi-globular, 3·5 to 4·5 μ in diameter, provided with a membrane of a brownish colour. Commonly found in decaying organic substances.

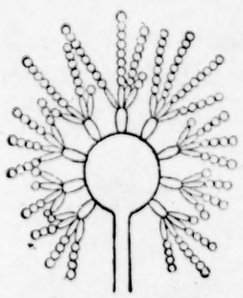

FIG. 404.—STERIGMATOCYSTIS FRUCTIFICATION.
(After Brumpt.)

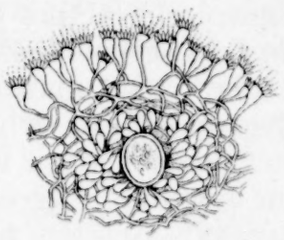

FIG. 405.—STERIGMATOCYSTIS NIDULANS EIDAM.
(After Eidam, from Brumpt.)

It was first observed in man by Cramer, who observed it in the ear of a deaf patient. Later it was observed by Fürbringer and others in mycotic affections of the lungs.

Sterigmatocystis nidulans Eidam 1883.

Synonym.—*Aspergillus nidulans* Eidam 1883.

Mycelium of a greenish colour. Conidiophores are erect, 0·5 to 0·8 millimetre in length. Presence of primary sterigmata, supporting secondary sterigmata, each of which gives rise to a chain of conidia. Conidia small (2 to 3 μ in diameter), globular, of a greenish colour. The fungus has been completely investigated by Pinoy: grows badly in Raulin's liquid, better on Sabouraud's; is non-pathogenic for rabbits. This species is found living saprophytically in certain nests, hence the name *S. nidulans*. In man it has been found in several cases of otomycosis. Nicolle and Pinoy have found it, or a very similar species, in a case of mycetoma with white granules.

Remarks on Aspergillomycoses and Sterigmatocystomycoses.—These affections are common in man and the lower animals.

1. ASPERGILLOSIS OF THE LUNGS; ASPERGILLAR PSEUDO-TUBERCULOSIS; PNEUMOMYCOSIS OF ASPERGILLAR ORIGIN.—*Aspergilli*

develop sometimes in the mucosa of the trachea, of the bronchi, and even in the pulmonary alveoli, without giving rise to any pathogenic effect. In other cases the fungi induce pseudo-membranous and ulcerative lesions. A very serious affection is a form of pseudo-tuberculosis (pseudo-tuberculosis aspergillina), characterized by the presence of mycotic nodules in the lungs, liver, kidneys, and other organs. This affection, due to *A. fumigatus*, is very common in some parts of France among pigeon-breeders (*gaveurs de pigeons*). The same affection attacks the pigeons. The infection is probably caused by spores of *A. fumigatus* being present in the grains used for feeding the pigeons.

2. ASPERGILLOSIS OF THE EYE.—*A. fumigatus* has been found several times in ulcers of the cornea (keratomycosis aspergillina).

3. ASPERGILLOSIS OF THE EAR (OTOMYCOSIS ASPERGILLINA).—Various species of *Aspergillus* have been found in the ear. In some cases they may give rise to a serious otitis, deafness, and tinnitus. Aspergillosis of the ear is not rare in the tropics. Syringing with hydrogen peroxide two parts and alcohol one part is useful.

4. ASPERGILLOSIS OF THE NOSE.—*A. glaucus* and *A. fumigatus* have been found in the nasal cavities ; the first apparently does not cause any disturbance. The second causes various inflammatory symptoms.

5. ASPERGILLOSIS OF WOUNDS AND ULCERS.—In wounds not properly treated, and in old ulcers, *Aspergilli* have been occasionally found.

6. ASPERGILLOSIS OF THE URETHRA.—In several cases a black urethral discharge has been observed, due to *Sterigmatocystis nigra*.

7. ASPERGILLOSIS OF THE SKIN.—Montoya's investigation has shown that several varieties of pinta are due to fungi of the genus *Aspergillus*. Another important tropical skin disease, tinea imbricata, was believed until recently to be due to an *Aspergillus*—*A. tokelau* Wehmer 1903. In our experience the fungi of tinea imbricata never shows aspergillar fructifications, and cannot be considered to be *Aspergilli*.

Aspergilli may also cause some varieties of mycetoma.

Genus **Madurella** Brumpt 1905.

White thallus, living parasitic in animal tissues—connective tissue, muscles, and bones. Mycelial threads of various sizes, 1 to 8 or 10 μ in breadth, septate, at times ramified. No special fructification ; reproduction takes place only by fragmentation of the thallus. Sclerotia often dark brownish, containing a variable number of large roundish bodies, 8 to 30 μ in diameter (chlamydospores).

This genus contains two well-defined species and a doubtful one : *Madurella mycetomi* Laveran 1902, *M. tozeuri* Ch. Nicolle and Pinoy 1908, *M. bovoi* Brumpt 1910.

Madurella mycetomi Laveran 1902.

Synonym.—*Streptothrix mycetomi* Laveran 1902.

Description.—All the characters of genus *Madurella*. Attempts at inoculation in the lower animals have failed.

Cultures.—Wright, in a case of black mycetoma in America, cultivated a white fungus which in old cultures showed black

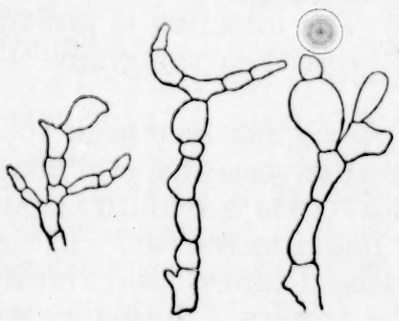

FIG. 406.—MADURELLA MYCETOMI LAVERAN.
(After Brumpt.)

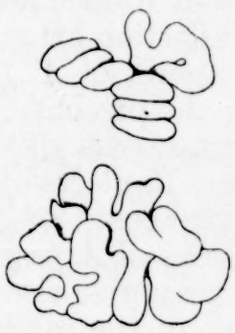

FIG. 407.—GRAINS OF INDIELLA REYNIERI BRUMPT.
(After Brumpt.)

sclerotia. Brumpt doubts whether Wright's hyphomycete is *M mycetomi*. Chatterjee has also grown a fungus in India from a case of mycetoma with black granules. Brault has successfully cultivated the fungus in Africa; the cultures are very similar to those of *M. tozeuri*, but numerous sclerotiæ are present.

Pathogenicity.—This fungus causes Carter's black mycetoma.

Madurella tozeuri Ch. Nicolle and Pinoy 1908.

Synonyms.—*Oospora tozeuri* Ch. Nicolle and Pinoy, *Mycoderma tozeuri* Verdun 1913.

Causes a variety of black mycetoma in Algeria and Tunis. Masses of the fungus give rise to small, hard black grains. During parasitic life the mycelium is septate, ramified, 1 to 4 μ in breadth; chlamydospores present. On maltose agar the fungus grows best at 35° C., giving rise to whitish colonies, which later become yellowish, while the medium becomes of a brownish or black colour. Structures similar to the so-called 'favus claviform bodies' have been observed; some hyphæ consist of strings of small cylindrical elements 4 μ in length and 2 μ in breadth. In cultures definite sclerotia are generally absent. This fungus has been successfully inocluated by Pinoy in the pigeon.

Madurella bovoi Brumpt 1910.

Temporary Species.—Bovo, in Italy, in a case somewhat resembling madura foot, found microscopically mycelial filaments and spore-like bodies of black colour. The fungus was not cultivated. Bovo believed it might be *Aspergillus fumigatus* or *Sterygmatocystis nigra*. Brumpt considers it to be more probably a madurella.

Genus Indiella Brumpt 1906.

White thallus, living parasitic in various animal tissues—connective tissue, muscles and bones. Mycelial threads 1 to 8 or 10 μ septate, ramified, never secreting—in contrast to the fungi of genus *Madurella*—any black pigment. Masses of mycelial threads form sclerotia-like bodies or grains of various shape containing chlamydospores.

Indiella mansoni Brumpt 1906.

Mycelial threads are septated, white, thin, 1·5 to 2 μ when young, larger (3 to 5 μ) and of irregular shape when old. Numerous spherical chlamydospores, generally terminal, 5 to 12 μ in diameter. Grains (sclerotia) very small, of $\frac{1}{5}$ to $\frac{1}{4}$ millimetre, white, lenticular or reniform, very hard, do not soften by keeping in caustic potash. The fungus has not been grown.

Pathogenicity.—It is the cause of Manson's white mycetoma, of which only one case is known.

Indiella reynieri Brumpt 1906.

White thallus. Most mycelial filaments are very thin, 1 to $1\frac{1}{2}$ μ, septated ; some—those at the periphery—are of irregular shape, much broader (4 to 5 μ), moniliform. Nearly every mycelial thread has at the peripheral extremity a terminal chlamydospore, 5 to 20 μ, often septate in two or three cells. Grains or sclerotia are small, less than 1 millimetre in diameter, coiled up like the excrementa of earth-worms.

Pathogenicity.—This fungus causes a variety of mycetoma with white grains (Reynier's white mycetoma), of which there is only one case on record—a European patient who had never left France. The case was observed and reported on by Dr. Reynier.

Indiella somaliensis Brumpt 1906.

Mycelial threads extremely thin (0·5 μ), septated at long intervals ; when old, may be broader and take a moniliform appearance. The ampulliform formations, 1·5 to 2·5 μ in diameter, which are often seen, are probably intercalary chlamydospores. The grains formed by dense felting of mycelial threads are of a yellowish-reddish colour, slightly ovoid or roundish, extremely hard, the cementing substance in which the mycelial threads are embedded not softening in liquor potassæ. This fungus has not been grown, but, according to Brumpt, a nocardia easily grown can be found living symbiotically in the tissues with *I. somaliensis*.

Pathogenicity.—This fungus causes Bouffard's white mycetoma, which is common in Somalia and India.

Family Pyrenomycetes.

Ascomycetous fungi in which the asci are contained in a perithecium presenting an orifice at the apex for the escape of the spores. According to some authors, species of this family have been found parasitic in man. This is very doubtful, though Schubert states that he found in the nasal mucus of a patient an organism closely allied to *Botrytis bassiana*, which latter species, as is well known, causes the disease of silkworm called muscardin.

ORDER BASIDIOMYCETES.

Basidiomycetes have a septate mycelium, and are devoid of sexual reproduction. They reproduce by formation of basidia. Other accessory fructifications may be present—as, for example, chlamydospores. The basidia are of two principal types : (1) autobasidia ; (2) protobasidia.

The autobasidia are large, unseptated cells, giving rise at their apices to four delicate sterigmata, each of which bears a spore.

The protobasidia are septated, and appear in two chief forms :

A. Septated into four cells, each giving rise to a spore from a lateral inserted sterigma.

B. Septated by walls intersecting at right angles, each cell ending in an elongated tubular sterigma.

Of the Basidiomycetes one species (*Ustilago phyodytes*) of the family Ustilagineæ is of special importance while two others (*U. carbo* and *Tilletia levis*) may produce otomycosis.

Ustilago hypodytes Schlecht.

Synonyms.— *Dendrodichium microsporus* Brigi, *Sporotrichum dermatodes* Kane.

The mycelium penetrates the stem and leaves of reeds (*Arundo donax*) in some parts of Provence, Italy, and Greece. After a time the mycelium produces innumerable so-called brand spores by a process of segmentation of its profusely branched hyphæ. In this way the mycelium is transformed into a brown dark mass of spores.

These brand spores, as regards the mode of their formation, may be considered chlamydospores. The brand spores are resting spores ; they are scattered by the wind, and after an interval of rest they germinate, producing conidiospores of a basidium-like type.

The spores of *U. hypodytes* are the cause, according to most authors, of a peculiar affection found among workers who have to do with the cutting, etc., of reeds (*A. donax*). This affection is called ' frienite,' or ' frien disease.' The patient complains of symptoms somewhat resembling hay-fever—sneezing, headache, etc.—and, in addition, shows an erythematous erysipeloid eruption on the uncovered part of the body, and often also on the genital organs, which may become greatly œdematous. Desquamation follows.

According to other observers, the cause of this peculiar disease is to be found, not in the spores of *Ustilago*, but in an insect—*Aclerda berlesei*, discovered by Berlese—which often swarms on various reeds. The workers in manipulating the canes, squash some of these insects, and the irritating juice exuding therefrom produces a dermatitis of an erythematous type.

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CHAPTER XXVIII

FUNGI (*concluded*)

Hyphomycetes — Nocardia — Monilia — Trichothecium — Glenospora — Sporotrichum — Trichosporon — Pityrosporum — Hemispora — Malassezia — Enantiothamnus — Cladosporium — Scopulariopsis — Acremonium — Monosporium — References.

ORDER HYPHOMYCETES (MUCIDINEES OR FUNGI IMPERFECTI).

THIS order contains groups of very different fungi, the botanical position of which cannot be conclusively determined in the present state of our knowledge. Reproduction is by conidia only. For the classification of these fungi it is necessary to take into account, not only their morphological botanical characters, but also their biological characters and pathogenic properties.

The following genera of hyphomycetes contain species parasitic in man: (1) *Nocardia* Toni and Trevisan 1889, (2) *Monilia* Persoon 1801, (3) *Trichothecium* Link 1824, (4) *Glenospora* Berk and Curtis, (5) *Sporotrichum* Link 1809, (6) *Trichosporon* Behrend 1890, (7) *Pityrosporum* Sabouraud 1895, (8) *Hemispora* Vuillemin 1906, (9) *Malassezia* Ch. Robin 1853, (10) *Enantiothamnus* Pinoy 1911, (11) *Cladosporium* Link 1809, (12) *Scopulariopsis* Bainier, (13) *Acremonium* Link 1809, (14) *Monosporium* Bonord and Saccardo 1898.

Genus Nocardia Toni and Trevisan 1899.

Mycelial filaments of various sizes, but generally very thin (1 μ or less), often branching, non-septate, and without differentiated nuclei. In certain species during parasitic life some mycelial threads terminate in club-like formations and show a radial arrangement. It is doubtful whether these club-like formations form intrinsic parts of the fungus or are partly products of reaction of the invaded tissues. Masses of mycelia may form in the tissues peculiar grains (sclerotia) of various size, shape, colour and consistency. Some species are facultative aërobic, others strictly anaërobic. All are Gram-positive, and several acid-fast. In cultures the mycelium very often undergoes fragmentation, and only bacillary and coccus-like bodies may be seen. These fungi are parasitic in man and lower animals, and may live as saprophytes or parasites on plants.

Pinoy divides the genus *Nocardia* into two :—

1. **Nocardia** Toni and Trevisan.—Bacillary-like mycelium ; no well-defined spores ; club-like formations generally absent ; facultative, aërobic.

2. **Conistreptothrix** Pinoy.—Well-defined spores with distinct membrane ; club formations often present ; anaërobic.

There are many points in favour of Pinoy's classification, which will probably be accepted generally in the early future.

TABLE SHOWING NOCARDIAS PARASITIC IN MAN.

Genus.		Species.
Nocardia Toni and Trevisan 1899	Well-defined club-like formations present	N. bovis Harz 1877.
		N. israeli Kruse 1896.
		N. thibiergei Ravaut and Pinoy 1909.
		N. rosenbachi Kruse 1896.
	Club-like formations absent or rare or not very distinct	N. foersteri Cohn 1874.
		N. asteroïdes Eppinger 1890.
		N. maduræ Vincent 1894.
		N. brasiliensis Lindenberg 1909.
		N. garteni Brumpt 1910.
		N. pelletieri Laveran 1906.
		N. luteola Foulerton and Jones.
		N. dassonvillei Brocq-Rousseu 1907.
		N. aurea Du Bois St. Severin.
		N. carougeaui Brumpt 1910.
		N. minutissima Burchardt 1859.
		N. liquefaciens Hesse 1892.
		N. pulmonalis H. Roger, Bory and Sartory 1909.
		N. tenuis Castellani 1911.
		N. hominis Foulerton 1906.
		N. rivierei Verdun 1912.
		N. candida Petruschky.
		N. odorifera Rubmann 1895.
		N. fusca Kareacki 1911.
		N. decussata Langeron and Chevalier 1912.
		N. carnea Rossi Doria 1891.
		N. enteritidis Pottien 1902.
		N. buccalis H. Roger, Bory and Sartory 1909.
		N. lasserei Verdun 1912.
		N. lingualis Guéguen 1908.
		N. ponceti Verdun 1912.

The modern tendency is also to place in the genus *Nocardia* the *Bacillus tuberculosis*.

Nocardia bovis Harz 1877.

Synonyms.—*Actinomyces bovis* Harz 1877, *Discomyces bovis* Rivolta 1877, *Nocardia actinomyces* Toni and Trevisan 1889, *Streptothrix actinomyces* Rossi-Doria 1891, *Oospora bovis* Sauvageau and Radais 1892, *Actinomyces bovis sulphureus* Gasperini 1894, *Nocardia bovis* R. Blanchard 1895, *Cladothrix actinomyces* Mace 1897, *Discomyces bovis* R. Blanchard 1900, *Streptothrix spitzi* Lignières and Spitz 1903.

This *Nocardia* is the cause of some cases of human and bovine actinomycosis, and of the actinomycotic mycetoma. The fungus lives parasitically in most tissues, in which it gives rise to degenerative and purulent changes. In the pus small, soft yellow granules—so-called ' sulphur grains '—are seen. These sulphur grains consist of masses of mycelium. At the periphery of the granule the threads are radially arranged, and their free extremities become club-like, 10 to 20 μ in length and 8 to 10 μ in breadth. These peculiar club-like formations have been considered by some authorities to be degeneration forms of the fungus, but Brumpt has demonstrated that they are young active forms, and disappear in old granules. Other writers consider that these club-like formations do not form an intrinsic part of the fungus, but are due to reactive changes in the tissues.

Cultures.—The fungus grows easily on agar, glycerinated agar, gelatine, broth, potato, and other media. Optimum temperature, 35° to 37° C. On glycerinated agar the fungus grows fairly rapidly, giving rise to small, dry, coarsely granular, brown-yellowish colonies, which latter coalesce together. The fungus is Gram-positive, but not acid-fast.

Saprophytic Life.—The fungus is found saprophytic on the spikelets of some cereals (*Phleum pratense* Linnæus, *Hordeum miurnum* Linnæus, etc.).

Pathogenicity.—The experimental reproduction of the disease by inoculating pure cultures has not so far succeeded. Wright therefore goes so far as to say that *Actinomyces bovis* is a contamination.

Varieties.—Gasperini describes three varieties: *N. bovis*, *N. bovis sulphurca-alba*, *N. bovis luteo-rosea*. Caminiti has described a variety which he thinks may be a new species.

Nocardia israeli Kruse 1896.

Synonyms.—*Streptothrix israeli* Kruse 1896, *Cohnistreptothrix israeli* Pinoy 1911.

Found in some cases of human and bovine actinomycosis. It differs from *N. bovis* by being strictly anaërobic. Inoculations of pure cultures have reproduced actinomycotic lesions, while so far such experimental lesions have not been obtained by using cultures of *N. bovis*.

Wright states that *N. israeli* is the real cause of actinomycosis, while *N. bovis* would be only a contamination or a saprophytic agent. We agree, however, with Pinoy's opinion that the clinical features of actinomycosis may be due to several germs: in man Pinoy has found *N. bovis* and *N. israeli*; in oxen *N. israeli* in most cases, but also *N. bovis*, the actinobacillus, and mixed infections.

The actinobacillus of Lignières and Spitz, very common in South America, gives rise to a type of actinomycosis of cattle affecting generally the tongue and neck, in which no grains are found. The germ in the affected tissues appears in the shape of a club-like bacillus. Cultivation is difficult, the best medium being glucose serum agar. The colonies are minute, bluish,

or translucid, with irregular edge. The germ generally dies out after two or three subcultures. Pinoy and Ravaut have described a case of meningitis in man due to this bacillus.

Nocardia foersteri Cohn 1874.

Synonyms.—*Streptothrix foersteri* Cohn 1874, *Oospora foersteri* Radais et Sauvageau, 1892, *Discomyces foersteri* Blanchard 1895, *Cohnistreptothrix foersteri* Pinoy 1911.

Mycelial threads very slender, seldom ramified, often terminating in a chain of rod-like or coccus-like elements. Masses of the fungus form some peculiar white bodies or concretions (Désmarres' dacryolithes), about 2 millimetres in diameter, which are occasionally found in the lachrymal canals of man.

The fungus has been cultivated with difficulty aërobically and anaërobically by several authors, among whom Kastalky, Axenfeld, Morax, and Landrieu. The last-named has made a thorough investigation of the fungus, which, according to him, shows a slow growth and gives rise on maltose agar to small cerebriform colonies of a grey-stone colour.

The peculiar concretions found in the lachrymal canals were first studied by Cesoin in 1670 and Sandifors in 1779. Désmarres, in 1842, considered them to be calculi composed of lime salts, and indicated them by the name of dacryolithes. Gruby believed they were induced by the fungus of Favus, but his observations remained unpublished. A. de Graefe, in 1854, first stated in a published work that these concretions were of mycotic origin. He thought they were due to *Achorion schoenleini*, while Conheim and others believed them to be caused by *Nocardia* (*Streptothrix*) *buccalis*. In 1875 Cohn described the fungus under the name of *Streptothrix foersteri*.

Nocardia rosenbachi Kruse 1896.

Synonym.—*Streptothrix rosenbachi* Kruse 1896.

Isolated by Rosenbach in a case of dermatitis, called by him 'erysipeloid.' Mycelial threads very slender; some terminate in club-like swellings. Can be cultivated on the usual laboratory media. Does not liquefy gelatine.

Nocardia asteroïdes Eppinger 1890.

Synonyms.—*Cladothrix asteroïdes* Eppinger 1890, *Streptothrix eppingeri* Rossi-Doria 1891, *Oospora asteroïdes* Sauvageau and Radais 1892, *Nocardia asteroïdes* R. Blanchard 1895, *Discomyces freeri* Musgrave and Clegg 1907.

Found in mycetoma and in cases of abscess of the brain. Mycelial threads very slender (0·2 μ wide); the mycelial articles become easily dissociated, when they look bacillus-like. This fungus is acid-fast and is very similar to *Bacillus tuberculosis*, but grows much more quickly on ordinary media: obligative aërobe. Inoculations in the rabbit and guinea-pig produce a form of pseudo-tuberculosis histologically indistinguishable from true tuberculosis.

McCallum has found a *Nocardia* very similar to *N. asteroïdes* in a case of peritonitis.

Nocardia brasiliensis Lindenberg 1909.

Found by Lindenberg in a case of mycetoma of the leg in Brazil. Small white-yellowish, soft, moriform granules (0·1 to 0·5 millimetre), consisting of very delicate ramified mycelial tubes (0·0521 μ in diameter). Easily cultivated. Pinkish growth on Sabouraud's medium.

Nocardia maduræ Vincent 1894.

Synonyms.—*Streptothrix maduræ* H. Vincent 1894, *Nocardia maduræ* R. Blanchard 1895.

It causes Vincent's white mycetoma, very commonly found in Africa and Asia. The 'grains' which are found in the pus of such cases are soft, white, or slightly yellowish, and have a *mulberry-like* surface. At the periphery of the grains radiating filaments are found, but claviform swellings are usually absent; mycelial threads are always very slender (1 to 1½ μ). The fungus can be grown on the ordinary media; facultative aerobe. On glycerinated agar it forms discoid colonies, white in the centre and reddish at the periphery. In the cultures the mycelial threads are as slender as in the grains. Some of the mycelial threads have at their extremities short chains of small conidial elements. Gram-positive, but not acid-fast.

It is to be noted that this fungus very rarely produces bone lesions. Most strains are inoculable into monkeys.

Nocardia pelletieri Laveran 1906.

Synonyms.—*Micrococcus pelletieri* Laveran 1906, *Oospora pelletieri* Thiroux and Pelletier 1912, *Nocardia pelletieri* Pinoy 1912.

Very thin, delicate mycelium, easily dissociated. Some mycelial threads appear as strings of coccus-like bodies. Gram-positive. Thiroux and Pelletier have succeeded in growing it on Sabouraud's agar. Growth rather slow; colonies small, cerebriform, of a coral-red colour.

This species is closely allied to *N. maduræ* Vincent, from which it differs by the more abundant sporulation and the colonies being of a brighter red (coral-red) colour.

Pathogenicity.—Causes a type of mycetoma with small red grains, common in Senegal.

Nocardia dassonvillei Brocq-Rousseu 1907.

Synonym.—*Streptothrix foersteri* (Gasperini 1890).

Very thin ramified, mycelial threads, which easily become fragmented and dissociated into bacillary-like bodies. Numerous spherical coccus-like bodies (spores) present. Gram-positive. The fungus grows fairly well on gelatine, giving rise to small white, roundish colonies. This fungus has been found by Landrieu and Liégard in a case of conjunctivitis in an old lady who powdered her face extensively several times daily with rice-powder. The authors

suggest that the fungus may have been present in the rice-powder, as the same fungus is known to be found in several decaying cereals.

Gasperini isolated in 1890 from the air a *Nocardia* which he identified to be *N. foersteri*. Further researches (Landrieu) have shown Gasperini's fungus to be *N. dassonvillei*.

Nocardia decussata Langeron and Chevalier 1912.

Synonym.—*Discomyces decussatus* Langeron and Chevalier 1912.

Found by Langeron and Chevalier in a patient presenting peculiar whitish, dry, squamous patches. The fungus grows on ordinary media extremely slowly. Colonies milk-white, the central portion of which is slightly elevated and flattened, but has a minute nodule in the middle ; very often four furrows, forming a cross, are seen. The mycelial threads are thin, non-septate, and are easily dissociated into roundish bodies, 1 to 1·5 μ in diameter.

The pathogenic rôle of this fungus is doubtful.

Nocardia carougeaui Brumpt 1910.

Synonym.—*Discomyces carougeaui* Brumpt 1910.

Discovered by Fonteynont and Carougeau in cases of juxta-articular nodules. In the nodules thin mycelial threads are seen, at times ramified, collected in bundle-like groups or arranged radially. Gram-positive. Attempts at cultivation have failed.

Nocardia thibiergei Pinoy and Ravaut 1909.

Discovered by Pinoy and Ravaut in a case of peculiar nodular affection of the subcutaneous tissues and muscles. In the lesions very thin (0·2 μ) fragile mycelial threads are seen, often dissociated in bacillary-like bodies. Masses of mycelia embedded in amorphous cementing substance form minute grains or sclerotia, with a maximum diameter of about 80 μ. Some filaments terminate in club-like formations about 3 μ in breadth, which are acid-fast.

The fungus is easily cultivated, aërobically and anaërobically. On maltose agar it produces small white colonies; on broth it develops only at the bottom of the tube.

Nocardia pulmonalis H. Roger, Bory and Sartory 1909.

In the parasitic stage may appear in the shape of bacillary-like bodies, about 0·5 μ in diameter. In cultures (maltose broth) thin mycelial filaments, 0·5 μ in diameter, are present, some branching, some terminating in club-like formations. Some mycelial threads are very fragile and become fragmented into strings of bacillary or coccus-like bodies.

Pathogenicity.—Causes a type of pseudo-tuberculosis. In the expectoration occasionally small white granules, composed of masses of the fungus, are present. Sartory has found the fungus in a case of otitis.

FIG. 408. — NOCARDIA PULMONALIS H. ROGER, BORY AND SARTORY. (After Roger and Sartory.)

FIG. 409.—NOCARDIA BUCCALIS ROGER, BORY AND SARTORY. (After Roger and Sartory.)

Nocardia candida Petruschky 1901.

Found in sputum.

Nocardia aurea Du Bois St.-Séverin 1902.

Found in a case of ulcerative conjunctivitis.

Nocardia odorifera.

Found by Rullmann in a case of chronic bronchitis.

Nocardia liquefaciens Hesse 1892.

Synonym.—*Cladothrix liquefaciens* Hesse 1892.

Gives rise to white colonies on gelatine, and later liquefies the medium. Was isolated from a case of actinomycosis.

Nocardia ponceti Verdún 1912.

Not cultivable on agar or gelatine. Grows well on serum, where it takes a bacillary-like form. Found by Moorhof, Dor, and Poncet in a case of myomycosis resembling actinomycosis.

Nocardia fusca Karwacki 1911.

Isolated by Karwacki from the sputum of a tubercular patient. Dark yellowish colour.

Nocardia luteola Foulerton and Jones.

Found in a case of purulent conjunctivitis.

Nocardia carnea Rossi-Doria 1891.

Isolated by Baldoni from a case of chronic bronchitis. Red colonies.

Nocardia garteni Brumpt 1910.

Synonyms.—*Cladothrix liquefaciens* No. 2 Garten 1895, *Discomyces garteni* Brumpt 1910.

Liquefies gelatine. On potatoes gives rise to white colonies, while the medium takes a greenish colour. Was isolated from a case of actinomycosis.

Nocardia enteritidis Pottien 1902.

Found in cases of enteritis by Pottien.

Nocardia buccalis H. Roger, Bory and Sartory 1909.

Synonyms.—*Osopora buccalis* H. Roger, Bory and Sartory 1909, *Discomyces buccalis* Brumpt 1910.

Thin mycelial filaments (0·7 to 0·8 μ). Some ramified mycelial threads are very fragile, becoming fragmented into strings of bacillary-like or coccus-like bodies. Can be cultivated.

Pathogenicity.—May give rise to a form of stomatitis somewhat resembling thrush. It has been found also in tonsillar abscesses.

Nocardia lasserei Verdun 1912.

Synonym.—*Nocardia sp.* (?) Lasserre 1904.

Found by Lasserre in 1904 in an ulcerative lesion situated on the pharynx and upper lip. Mycelial filaments very thin (0·5 to 0·75 μ) ; fragile, club-like formations present. Can be cultivated. Pathogenic to rabbits and guinea-pigs but only by intracerebral injection.

Nocardia lingualis Guéguen 1908.

Synonym.—*Oospora lingualis* Guéguen 1908, *Discomyces lingualis* (Brumpt 1910).

In the parasitic stage the fungus appears in the shape of bacillary bodies, less than 0·3 μ in diameter. In cultures it shows a mycelial type with very thin filaments. It is probably non pathogenic ; it has been found in cases of lingua nigra in association with *Cryptococcus linguæ pilosæ.*

Nocardia rivierei Verdun 1912.

Isolated by Riviere (1896) in a case of multiple abscesses. Is cultivable on ordinary media.

Nocardia hominis Foulerton 1906.

Synonyms.—*Streptothrix hominis* Foulerton 1906, *Oospora hominis* Ridet 1911.

Discovered by Foulerton in a case of multiple abscesses ; was present also in the expectoration of the same patient. Foulerton has found similar fungi (*N. hominis III.*) in cases of appendicitis.

Nocardia minutissima Burchardt 1859.

Synonyms.—*Microsporum minutissimum* Burchardt 1859, *M. gracile* Balzer 1883, *Sporotrichum minutissimum* Saccardo 1896, *Discomyces minutissimus* P. Verdun 1907, *Microsporoides minutissimus* Neveu Lemaire 1906, *Oospora minutissima* Ridet 1911.

Mycelial threads extremely thin (0·6 μ) ; seldom ramified. The

Pathogenicity.—Causes a type of pseudo-tuberculosis. In the expectoration occasionally small white granules, composed of masses of the fungus, are present. Sartory has found the fungus in a case of otitis.

FIG. 408. — NOCARDIA PULMONALIS H. ROGER, BORY AND SARTORY. (After Roger and Sartory.)

FIG. 409.—NOCARDIA BUCCALIS ROGER, BORY AND SARTORY. (After Roger and Sartory.)

Nocardia candida Petruschky 1901.

Found in sputum.

Nocardia aurea Du Bois St.-Séverin 1902.

Found in a case of ulcerative conjunctivitis.

Nocardia odorifera.

Found by Rullmann in a case of chronic bronchitis.

Nocardia liquefaciens Hesse 1892.

Synonym.—*Cladothrix liquefaciens* Hesse 1892.

Gives rise to white colonies on gelatine, and later liquefies the medium. Was isolated from a case of actinomycosis.

Nocardia ponceti Verdun 1912.

Not cultivable on agar or gelatine. Grows well on serum, where it takes a bacillary-like form. Found by Moorhof, Dor, and Poncet in a case of myomycosis resembling actinomycosis.

Nocardia fusca Karwacki 1911.

Isolated by Karwacki from the sputum of a tubercular patient. Dark yellowish colour.

Nocardia luteola Foulerton and Jones.

Found in a case of purulent conjunctivitis.

Nocardia carnea Rossi-Doria 1891.

Isolated by Baldoni from a case of chronic bronchitis. Red colonies.

Nocardia garteni Brumpt 1910.

Synonyms.—*Cladothrix liquefaciens* No. 2 Garten 1895, *Discomyces garteni* Brumpt 1910.

Liquefies gelatine. On potatoes gives rise to white colonies, while the medium takes a greenish colour. Was isolated from a case of actinomycosis.

Nocardia enteritidis Pottien 1902.

Found in cases of enteritis by Pottien.

Nocardia buccalis H. Roger, Bory and Sartory 1909.

Synonyms.—*Osopora buccalis* H. Roger, Bory and Sartory 1909, *Discomyces buccalis* Brumpt 1910.

Thin mycelial filaments (0·7 to 0·8 μ). Some ramified mycelial threads are very fragile, becoming fragmented into strings of bacillary-like or coccus-like bodies. Can be cultivated.

Pathogenicity.—May give rise to a form of stomatitis somewhat resembling thrush. It has been found also in tonsillar abscesses.

Nocardia lasserei Verdun 1912.

Synonym.—*Nocardia sp.* (?) Lasserre 1904.

Found by Lasserre in 1904 in an ulcerative lesion situated on the pharynx and upper lip. Mycelial filaments very thin (0·5 to 0·75 μ) ; fragile, club-like formations present. Can be cultivated. Pathogenic to rabbits and guinea-pigs but only by intracerebral injection.

Nocardia lingualis Guéguen 1908.

Synonym.—*Oospora lingualis* Guéguen 1908, *Discomyces lingualis* (Brumpt 1910).

In the parasitic stage the fungus appears in the shape of bacillary bodies, less than 0·3 μ in diameter. In cultures it shows a mycelial type with very thin filaments. It is probably non-pathogenic ; it has been found in cases of lingua nigra in association with *Cryptococcus linguæ pilosæ.*

Nocardia rivierei Verdun 1912.

Isolated by Riviere (1896) in a case of multiple abscesses. Is cultivable on ordinary media.

Nocardia hominis Foulerton 1906.

Synonyms.—*Streptothrix hominis* Foulerton 1906, *Oospora hominis* Ridet 1911.

Discovered by Foulerton in a case of multiple abscesses ; was present also in the expectoration of the same patient. Foulerton has found similar fungi (*N. hominis III.*) in cases of appendicitis.

Nocardia minutissima Burchardt 1859.

Synonyms.—*Microsporum minutissimum* Burchardt 1859, *M. gracile* Balzer 1883, *Sporotrichum minutissimum* Saccardo 1896, *Discomyces minutissimus* P. Verdun 1907, *Microsporoides minutissimus* Neveu Lemaire 1906, *Oospora minutissima* Ridet 1911.

Mycelial threads extremely thin (0·6 μ) ; seldom ramified. The

mycelial segments get easily dissociated, and have then the appearance of bacilli. Is the cause of erythrasma. Michele, Ducrey, and Reale claim to have cultivated it.

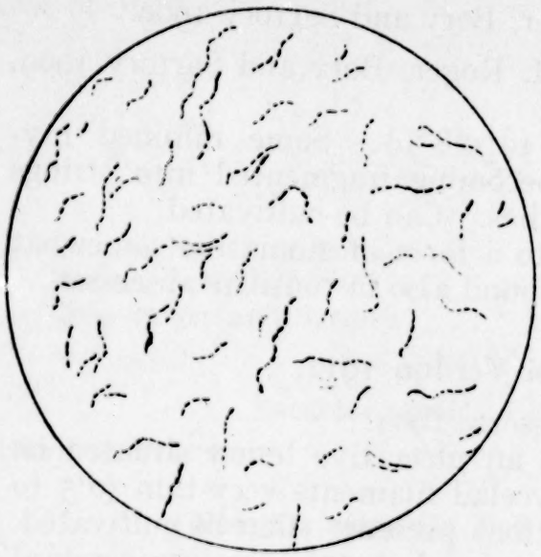

FIG. 410. — NOCARDIA MINUTISSIMA BURCHARDT.

FIG. 411.—NOCARDIA TENUIS CASTELLANI.

Nocardia tenuis Castellani 1911.

Found by Castellani in a tropical nodular affection of the hair of the axillary regions. In the parasitic stage, which is the only one known, cultivation having so far failed, the germ appears in the shape of bacillary-like bodies, varying in size ($\frac{1}{2}$ to $1\frac{1}{2}$ μ) packed together and embedded into an amorphous cementing substance. The bacillary bodies are either straight or bent, seldom branching. Gram-positive, but not acid-fast. Masses of this fungus embedded in amorphous cementing substance form the nodules of trichomycosis flava of the axillary regions.

In the black variety of the affection *Nocardia tenuis* is associated with a black pigment-producing coccus—*M. nigrescens* Castellani 1911. In the red variety the same *Nocardia* is associated with a red pigment-producing coccus.

For the growth of the black pigment-producing coccus, sugar media are more suitable than ordinary agar. On Sabouraud's agar the colonies of this coccus appear twenty-four to forty-eight hours after inoculation. They are roundish, at first white, but after a couple of days the centre of each colony turns black; at this pigmentation slowly spreads eccentrically. After a time the colonies coalesce into a jet-black mass. On glucose agar the coccus presents the same characters. On ordinary agar the pigmentation is much less marked or almost absent.

The red pigment-producing coccus, on the other hand, grows better and shows more pigmentation on ordinary agar than on maltose or glucose agar.

Genus Monilia Gmelin 1791.

Septate mycelium, the segments of which become easily dissociated. Fertile hyphæ often bear at their extremities short chains of rather large oval or roundish conidia. Temporarily we include in the genus *Monilia* certain genera recently introduced,

which according to many authorities have not yet been sufficiently defined. These genera are *Zymonema* De Beurmann and Gougerot 1909, *Parendomyces* Queyrat and Laroche 1909, *Parasaccharomyces* De Beurmann and Gougerot 1909. The fungi of the genus *Monilia* are generally easily grown on ordinary laboratory media, the best being Sabouraud's maltose agar and glucose agar. They usually grow better on slightly acid than on alkaline media. They grow also on ordinary agar. They generally grow under two types—the yeast-like type and the filamentous type.

Biological Characters.—Some species clot milk, others have no action on this medium ; some species liquefy gelatine and serum. Certain fungi of this genus, when growing on serum, produce a peculiar zone of brownish or black discoloration of the medium all round the growth. The biochemical properties and sugar reactions vary from species to species. Rabbits can be immunized for these fungi, and the immunization and agglutination reactions may be used in the differentiation of the various species.

Pathogenicity.—Fungi of this genus are the ætiological agents of thrush, some types of bronchomycoses, and some dermatomycoses.

Classification.—There has been and there is still a great deal of confusion in the classification of such fungi. Many of the species of this genus can hardly be distinguished on purely morphological and botanical characters. We are of opinion that the classification should be based, not only on morphological data, but also on biochemical characters and immunization phenomena. Among the biochemical properties, the most important are the actions on milk, gelatine, serum, and on sugar broths. A large number of sugars should be used in the same manner as is done in the classification of the various species of intestinal bacteria. It is to be noted that the reactions with certain sugars are constant, while with others (for instance, mannite) may vary. It is to be noted also that in analogy to intestinal bacteria, a species may be trained to ferment certain sugars on which it did not act when recently isolated.

While taking all this into account, we believe the investigation of the various biochemical reactions to be of great value for classifying these fungi.

Monilia albicans Robin 1853.

Synonyms.—*Oidium albicans* Robin 1853, *Syringospora robini* Quinquaud 1868, *Saccharomyces albicans* Rees 1877, *Monilia albicans* Zopf 1890, *Endomyces albicans* Vuillemin 1898.

One of the fungi giving rise to thrush. Widely different descriptions have been given of the so-called thrush-fungus. Some authorities (Hewett) state that the organism liquefies gelatine ; others affirm the reverse. Several writers give it as clotting milk, others as having no action on this medium. Castellani has demonstrated that man can be affected by numerous different species of *Monilia*, and that the term thrush-fungus (*Oidium albicans*, *Endomyces albicans*,

TABLE SHOWING PRINCIPAL BIOCHEMICAL AND CULTURAL REACTIONS OF THE FUNGI IN ALPHABETICAL ORDER:

Genus Monilia.	Litmus Milk.	Glucose.	Lævulose.	Maltose.	Galactose.	Saccharose.	Lactose.	Mannite.	Dulcite.	Dextrin.
M. albicans Robin	AC	AG	AGs	AGs	AG	Avs	O	O	O	O
M. blanchardi Cast.	Avs / Alk	AGs	A	A	A	A	O	O	O	O
M. bronchialis Cast.	O	AG	AG	AG	O	AGs	O	O	O	A
M. burgessi Cast. . .	O / Alk	AGs	A	AGs	A	AGs	O	O	O	O
M. chalmersi Cast.	As / Alk	AG	AG	As	AGs	AG	O	O	O	O
M. decolorans Cast. and Low.	DC	AG	AG	AG	A	A	O	O	O	A
M. enterica Cast.	O / Alk	AG	AG	AG	AG	AG	O	As	O	As
M. fæcalis Cast. . .	A / DPs	AG	AG	AG	AGs	AGs	O	O	O	O
M. guillermondi Cast.	O / Alk	AG	AG	As	A	AG	O	O	O	O
M. insolita Cast. . .	As / Alk	AG	AG	AG	AG	AG	O	As	O	O
M. intestinalis Cast.	ADs	AG	AG	As	A	A	O	O	O	O
M. krusei Cast. . .	O	AG	AG	O	O	O	O	O	O	O
M. lustigi Cast. . .	As / D	A	AGs	Avs	A	AGs	O	O	O	A
M. negrii Cast. . .	Avs / Alk	AG	AG	As	AGs	AG	O	O	O	O
M. nivea Cast. . .	O / Alk	AG	AG	AG	AG	AGs	O	O	O	O
M. nitida Cast. . .	A / DC	AG	AG	A	A	A	A	A	O	Avs
M. paratropicalis Cast.	As / Alk	AG	AG	AG	AG	AG	O	O	O	Avs
M. pseudo-tropicalis Cast.	ACs	AG	AG	O	AGs	AG	AG	O	O	O
M. perryi Cast. . .	As / D Alk	A	AGs	A	A	AGs	O	O	O	O
M. pinoyi Cast. . .	O	AG	AG	AG	O	O	O	O	O	O
M. pulmonalis Cast.	O / Alk D	AG	AG	AG	AGs	AG	O	Avs	O	O
M. rhoi Cast. . .	As / Alk	AG	AG	Avs	AGs	AG	O	O	O	O
M. rosea Zenoni . .	—	—	—	—	—	—	—	—	—	—
M. rotunda Cast. . .	AC	A	A	A	A	O	A	O	O	O
M. rugosa Cast. . .	A / PsCs	As	As	As	As	As	O	O	O	O
M. tropicalis Cast.	A	AG	AG	AG	AGs	AGs	O	O	O	O
M. zeylanica Cast.	ACs	A	A	A	A	A	As	O	O	A

Abbreviations used in the Table.—A=acid; G=gas; C=clot (milk), clear (broth and peptone water); CTP=clear at first, then thin pellicle present. D=decolorized. P=peptonized (milk), pellicle (broth). Alk=alkaline. A / Alk=acid, then alkaline. s=slight; vs=very slight.

CHARACTERS OF CERTAIN SPECIES OF MONILIA, WITH NAMES AFTER FIFTEEN DAYS' INCUBATION AT 35° C.

Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Broth.	Peptone Water.	Indole.	Gram.	Gelatine.	Serum.	Neutral Red.	Colour of Growth on Maltose Agar.
O	O	O	O	O	CTP	C	O	+	+	+s	O	White
As	O	O	Avs	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	OB	O	White
As	O	O	AGs	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	OB	O	White
AGs	O	O	O	O	CTP	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	OB	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
AGs	O	O	O	O	C	C	O	+	O	OB	O	White
AGs	O	O	O	O	C	C	O	+	O	O	O	White
AG	O	O	O	O	C	C	O	+	O	O	O	White
As or O	O	O	O	O	CTP	C	O	+	O	O	O	White
O	O	O	O	O	CTP	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
As	O	O	Avs	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
A	AGs	O	O	O	CTP	C	O	+	O	OB	O	White
O	O	O	O	O	C	C	O	+	O	O	O	White
—	—	—	—	—	—	—	—	—	O	O	—	Pink
O	O	O	O	O	C	C	O	+	O	O	O	White
O	O	O	O	O	C	C	O	+	O	O	O	Amber-yellowish
O	O	O	O	O	C	C	O	+	O	OB	O	White
Avs Gvs	O	O	Avs	O	C	C	O	+	O	O	O	White

B=brown pigmentation of the medium. O=negative result—viz., neither acid nor clot in milk; neither acid nor gas in sugar media; non-production of indol; non-liquefaction of gelatine or serum, as the case may be. +=positive result, liquefaction of medium.

Monilia albicans) has been in the past used to cover a number of different species, in the same manner that the term *B. coli* was for years applied to a multitude of different intestinal bacteria, when a few fermentation tests only were carried out. As the species *M. candidans* has to be divided into many species, we keep the term *M. albicans* for the species which we are now describing, and which clots milk and liquefies gelatine.

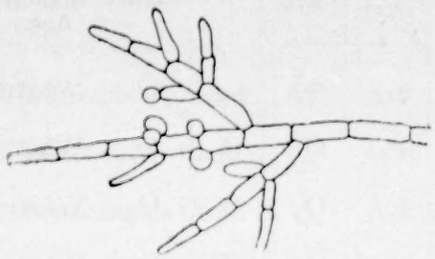

FIG. 412.—MONILIA ALBICANS ROBIN.

Parasitic Life.—This fungus forms white patches on the tongue and oral mucosa. The patches are easily detached. A particle of the patch examined microscopically shows septate mycelial threads, occasionally ramified, with segments straight or somewhat bent, and easily dissociated. Each segment is about 20 μ in length and 3 to 5 μ in breadth. At the terminal end of each mycelial thread three or four shorter ovoid elements are found, which reproduce by budding. Some similar ovoid or roundish globular refringent cells may be observed originating laterally at the septations of the mycelium. These globular elements (conidia) become detached, and reproduce by budding.

Cultures.—The fungus grows best of all on slightly acid Sabouraud's maltose agar or on glucose agar, but grows fairly well also on all alkaline media. In cultures the fungus appears under two forms—a globular form, morphologically similar to a typical yeast, and reproducing by budding ; a filamentous form, showing mycelial threads, simple or ramified. *Asci* and *internal spores*, as in the genus *Endomyces*, are absent. On Sabouraud's and glucose agar the growth is abundant, smooth, of a creamy-white colour ; on ordinary agar the growth is less abundant. Gelatine and serum are very slowly liquefied. Milk is rendered acid, and after a time it clots. The sugar reactions are given in the table.

Pathogenicity.—*M. albicans* is one of the fungi which gives rise to *thrush*. This condition may be due to several different fungi—*M. candidans*, *Endomyces vuillemini*, *M. tropicalis*, etc. *Thrush* is generally restricted to the oral mucosa, but in certain cases it may spread to the œsophagus, stomach, intestine. *M. candidans* has been found also in a few cases of bronchomycosis.

Monilia tropicalis Castellani 1909.

Synonym.—*Endomyces tropicalis* Castellani 1909.

Found by Castellani in Ceylon in many cases of bronchomycosis. In the expectoration round or oval shape yeast-like cells are seen, and at times segments of mycelium. Cultures are easily obtained on Sabouraud's or glucose agar, and even on ordinary agar. It grows more abundantly on slightly acid than on alkaline media.

On Sabouraud's and glucose agar the growth is abundant, creamy-white, with a smooth surface when young ; often slightly crinkled when old. The growth is composed practically of only globular yeast-like cells, while in the water of condensation globular cells and mycelium may be found together. A little mycelium may be found, however, occasionally in the growth on the slope. Ascus formations are absent. Gelatine and serum are not liquefied ; there is no brownish discoloration of the serum, as is the case with some other species of *Monilia* (*M. insolita*, etc.). Litmus milk is generally rendered acid, but is not clotted. The sugar reactions will be found in the table on pp. 822, 823. It produces acid and gas in glucose, lævulose, maltose, and also, in less amount, in galactose and saccharose.

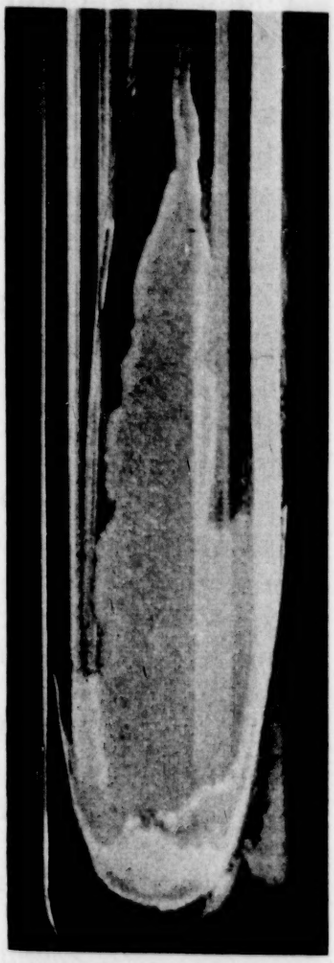

FIG. 413. — MONILIA TROPICALIS CASTELLANI.

Pathogenicity.—Is the commonest cause of a type of bronchomycosis (see Bronchomoniliasis, p. 1285). In Ceylon it has been found by Castellani also in a few cases of *thrush*, and in a case of *pseudo-diphtheria* which terminated fatally. This case was a little native girl, who developed white patches on the tonsils, uvula, and soft palate. The microscopical examination revealed absence of *B. diphtheriæ* and presence of *M. tropicalis*. Symptoms of bronchopneumonia soon developed, and the child died. At the autopsy the fungus was found in enormous amount in the bronchi ; it was pathogenic for guinea-pigs.

Monilia paratropicalis Castellani 1909.

Synonym.—*Endomyces paratropicalis* Castellani 1910.

Found in some cases of bronchomycosis by Castellani. Microscopically and on Sabouraud's and glucose agars, identical with *M. tropicalis*. Does not coagulate milk. Differs from the typical *M. tropicalis* by producing acid and gas in saccharose (see table).

The same fungus, or a very similar one, was found in two cases of blastomycosis of the skin in Ceylon.

Monilia pseudo-tropicalis Castellani 1910.

Synonym.—*Endomyces pseudo-tropicalis* Castellani 1910.

Found by Castellani in a few cases of bronchomycosis. Differs from *M. tropicalis* and *M. paratropicalis* by clotting milk. For the sugar reactions see table.

Monilia bronchialis Castellani 1910.

Synonym.—*Endomyces bronchialis* Castellani 1910.

Found in sputum. Colonies white. Has no action on milk, gelatine, serum. Sugar reactions are found in the table.

Monilia chalmersi Castellani 1912.

Found by Castellani in a case of bronchitis. Colonies of white colour. Renders the milk first slightly acid, then alkaline. Does not liquefy either gelatine or serum. Sugar reactions are collected in the table.

Monilia guillermondi Castellani 1910.

Synonym.—*Endomyces guillermondi* Castellani 1910.

Observed in sputum once by Castellani. Milk is rendered alkaline. Serum and gelatine are not liquefied. For sugar reactions see table.

Monilia nivea Castellani 1910.

Synonym.—*Endomyces niveus* Castellani.

Found in a sample of sputum which had not been collected in a sterile vessel. Of doubtful pathogenicity. For cultural and biochemical characters, see table.

Monilia nitida Castellani 1910.

Synonym.—*Endomyces nitidus* Castellani 1910.

Observed in a sample of sputum by Castellani. Of doubtful pathogenicity. Milk is rendered first acid, then decolourized and clotted. Other cultural characters are found in the table.

Monilia zeylanica Castellani 1910.

Synonym.—*Endomyces zeylanicus* Castellani 1910.

Found in sputum by Castellani. White colonies. Milk is rendered very acid and is slowly clotted. Gelatine and serum are not liquefied. For sugar reactions see table.

Monilia krusei Castellani 1909.

Synonym.—*Saccharomyces krusei* Castellani, *Endomyces krusei* Castellani.

Found in sputum by Castellani. In sputum it appeared as a saccharomyces, and in cultures had all the characters of a saccharomyces at first, but after several generations a little mycelium was present on Sabouraud's agar. The sugar reactions are found in the table. It produces acid and gas in glucose and lævulose.

Monilia pinoyi Castellani 1910.

Synonym.—*Endomyces pinoyi* Castellani 1910.

Found in sputum. Grows well on Sabouraud's and glucose agar, and other sugar media; also on ordinary agar, though less abun-

dantly. Does not clot milk; does not liquefy either gelatine or serum. Produces acid and gas in glucose, lævulose, maltose.

Monilia rugosa Castellani 1910.

Synonym.—*Endomyces rugosus* Castellani 1910.

Isolated from sputum by Castellani. Grows readily on Sabouraud's and other sugar media, and also on ordinary agar. The growth is very abundant, and from the very first is of a yellowish-amber colour and has a crinkled surface. The sugar reactions are found in the table. It is very doubtful whether this fungus really belongs to the genus *Monilia*.

FIG. 414.—MONILIA RUGOSA CASTELLANI 1910.

Monilia enterica Castellani 1911.

Synonym.—*Endomyces entericus* Castellani.

Found in stools by Castellani. Milk is rendered strongly alkaline. Gelatine and serum are not liquefied. For sugar reactions see table.

Monilia fæcalis Castellani 1911.

Synonym.—*Endomyces fæcalis* Castellani 1911.

Found in intestinal contents by Castellani. Milk is rendered first acid, then decolourized, and, later, slightly peptonized. Gelatine is not liquefied; serum is not liquefied, but a brownish pigmentation develops on the medium all round the growth. For sugar reactions see the table (p. 822).

Monilia insolita Castellani 1911.

Synonym.—*Endomyces insolitus* Castellani 1911.

Found in stools and in the saliva. The milk is rendered first slightly acid, then alkaline. On serum a zone of dark pigmentation develops on the surface of the medium round the growth. The medium is not liquefied. For other cultural characters see the table.

Monilia intestinalis Castellani 1911.

Synonym.—*Endomyces intestinalis* Castellani 1911.

Found in stools and saliva by Castellani. Colonies on solid media white. Milk first rendered acid, then slowly decolourized. The growth on serum is not surrounded by a zone of dark pigmentation. Further cultural characters are found in the table (p. 822).

Monilia rotunda Castellani 1911.

Synonym.—*Endomyces rotundus* Castellani 1911.

Found in saliva and stools by Castellani. Milk is rendered strongly acid and clotted. Serum and gelatine not liquefied. The sugar reactions are collected in the table.

Monilia rhoi Castellani 1909.

Synonym.—*Endomyces rhoi* Castellani 1909.

Found by Castellani in Ceylon in several cases of otomycosis, and once in a sample of tea. In the ear the fungus forms a whitish mass (generally embedded in wax), in which numerous long, septate mycelial threads, 2 to 3·5 μ in breadth, and numerous roundish free spores, 3·5 to 5 μ in diameter, are seen. On laboratory media it generally grows, showing a yeast-like type. Does not clot milk; does not liquefy gelatine and serum. The sugar reactions are quoted in the table.

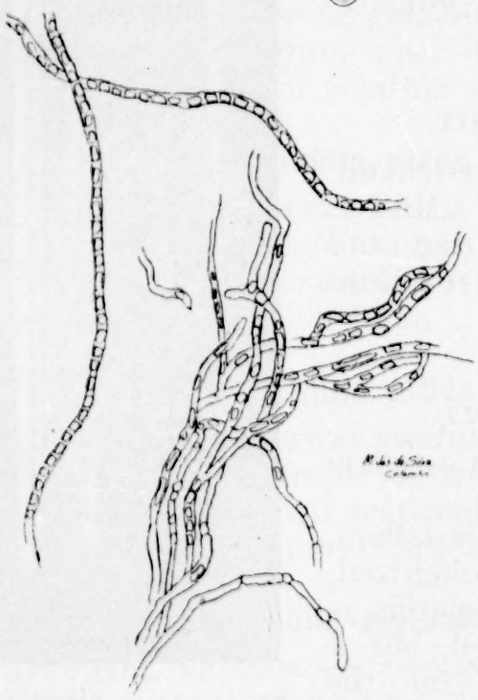

FIG. 415.—MONILIA RHOI CASTELLANI.

(From a fresh preparation. The free spores are not shown.)

In the cases of otomycosis the mycelium was abundant, the mycelial threads being very long and septate, 3 to 4 μ in breadth; very numerous free, round spores, 4 to 5 μ in diameter, were present For cultural characters see table.

Monilia burgessi Castellani 1912.

Synonym.—*Endomyces burgessi* Castellani 1911.

Isolated from the air. Grows abundantly on the usual sugar media, the growth being of a white creamy appearance. Does not render acid or coagulate milk. Does not liquefy serum or gelatine. On serum it produces a zone of peculiar brownish or black discoloration in the medium all round the growth. The sugar reactions are found in the table.

Monilia pulmonalis Castellani 1911.

Found by Castellani in sputum and also in samples of tea. For cultural characters see table.

Monilia lustigi Castellani 1912.

Found in samples of tea. Grows well on all sugar media, and also on ordinary agar, the growth being of a snow-white colour.

Renders litmus milk slightly acid, and then decolourizes it completely. Does not liquefy serum or gelatine. On serum it induces a narrow zone of black discoloration all round the growth. The sugar reactions are found in the table.

Monilia perryi Castellani 1912.

Found by Castellani in samples of tea-dust. The cultural characters and chemical properties are seen in the table.

Monilia blanchardi Castellani 1912.

Synonym.—*Endomyces blanchardi* Castellani 1912.

Isolated from tea-dust by Castellani. Grows abundantly on maltose, glucose, and other sugar media; also on ordinary agar, though less vigorously. The growth is of a white colour and smooth surface. Milk rendered at first very slightly acid, and then alkaline. No liquefaction of gelatine or serum. Does not produce gas in any sugar except, in small quantity, in glucose.

Monilia rosea Zenoni 1912.

Synonym.—*Oidium roseum non liquefaciens* Zenoni 1912.

The cultures on Sabouraud's and other sugar media are of a pinkish colour. Neither serum nor gelatine are liquefied.

Pathogenicity.—Was isolated by Zenoni in a peculiar case of hepatitis with fever and jaundice which ended fatally. Microscopically conidia and mycelial filaments could be seen very abundant in and about the smaller hepatic bloodvessels and the bile-ducts. The fungus is pathogenic to rabbits, guinea-pigs, and white rats.

Monilia subtilis Blanchard 1895.

Synonyms.—*Oidium subtile cutis* Babès 1895, *Mycoderma subtile* Verdun 1912.

Found by Babès in some ulcers on which the fungus produced white membranes. The mycelial threads were thinner than in most species of *Monilia*. There was dichotomous branching, and at the extremities of the mycelial threads ovoid conidia were present. Biochemical properties of the fungus not known. Pathogenic for the rabbit.

The same, or a very similar, fungus was later found by Clozel, de Boyer, and d'Antin in a peculiar pustular affection observed in cachectic children.

Monilia pulmonea Bennett 1842.

Synonyms.—*Oidium pulmoneum* Bennett 1842, *Oospora pulmonea* Saccardo 1886, *Mycoderma pulmoneum* Vuillemin 1891.

The organism was found in a case of pneumothorax by Bennett in 1842, it was observed again by Vuillemin in the sputum of a

tubercular patient in 1891, and in an ulcerative dermatitis by Balzer, Burnier and Gougerot in 1910. It grows under two types—a saccharomyces-like and a filamentous type. Colonies on glucose agar white. Biochemical reactions not given.

Monilia candida Bonorden.

Commonly found vegetating in decomposing vegetable matter; occasionally seen parasitic in Mammalia, giving rise to white patches on the tongue and buccal mucosa, somewhat similar to human *thrush*. Once found in a child in some white patches present on the tongue. Mycelium thinner than in most *Monilias* (1 to 1½ μ in breadth); conidia roundish, smooth, 7 to 8 μ in diameter. Biochemical actions of the fungus have not yet been investigated.

Monilia kochi von Wettstein 1885.

Synonym.—*Rhodomyces erubescens* Aster 1900.

Morphologically similar to *M. candida*; grows well on sugar media, where it produces pinkish colonies; was observed by Wettstein in a case of chronic acid dyspepsia. Biochemical properties not studied.

Monilia montoyai Castellani 1907.

Synonym.—*Monilia pictor* Neveu-Lemaire 1908.

Discovered by Montoya in cases of white pinta. Some fertile hyphæ are much thicker than others; the spores are large, globular (5 to 7 μ), and contain a large nucleus. Grows well on sugar media, giving rise to white-creamy colonies which rapidly fuse together. Biochemical properties of the fungus not known.

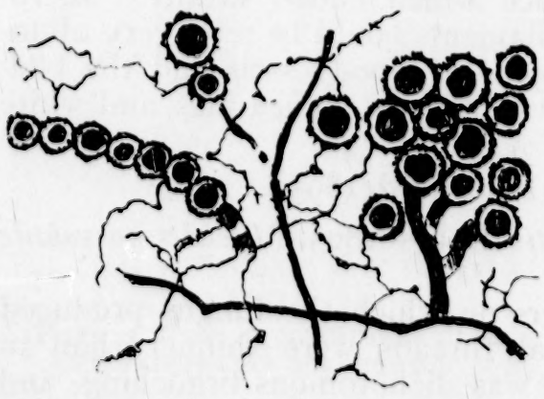

FIG. 416.—MONILIA MONTOYAI.

(After Montoya y Florez.)

Monilia cutanea de Beurmann, Gougerot and Vaucher 1909.

Synonyms.—*Oidium cutaneum* de Beurmann, Gougerot and Vaucher 1909, *Mycoderma cutaneum* Verdun 1912.

Isolated by de Beurmann, Gougerot and Vaucher from a case showing a peculiar gummatous condition clinically resembling sporotrichosis or syphilis. The fungus, on certain media (glycerine agar), vegetates as a saccharomyces, and ferments glucose; on other media (agar) mycelium and yeast-like cells are present, and the fungus does not ferment glucose any longer. On glucose agar the growth is white-yellowish, mammillary, with a radiating aureola. The fungus, unless injected in massive doses, is not very pathogenic to the rabbit, guinea-pig, and rat. Intraperitoneal injections of rather large doses induce in these animals a nodular peritonitis.

Monilia caoi Verdun 1912.

Found by Cao in the sputum of a tubercular patient in association with the tubercular bacillus. Yellowish colonies on ordinary agar. Pathogenic to rabbits. Biochemical reactions not given.

Monilia harteri Verdun 1912.

Synonym.—*Parasaccharomyces sp.* (?) de Beurmann and Gougerot.

Found by Harter in a case of enteritis which later developed hepatic bronchial and cutaneous lesions, due to the same fungus. On maltose agar and carrots the colonies are cream-white, and yeast-like cells only are generally found. In Raulin's liquid mycelial threads are present, septated, 2 μ in breadth. The fungus does not liquefy gelatine, does not coagulate milk; produces slight acidity, but not gas, in saccharose.

Genus Sporotrichum Link 1809.

During parasitic life the fungi of this genus appear as yeast-like cells. In cultures they show abundant septate or non-septate, ramified mycelium, and numerous oval or roundish spores, supported by short sterigmata. The dermatomycoses caused by these fungi are called sporothricoses; they are often characterized by the presence of gumma-like swellings.

Fungi belonging to this genus may live saprophytic in nature in vegetables, salads, etc., or parasitic in man and other mammalia and in insects.

TABLE OF SPOROTRICHA AFFECTING MAN.

Genus.	Species.
Sporotrichum Link 1809	Sp. schenki Hektoen and Perkins 1901.
	Sp. beurmanni Matruchot and Ramond 1905.
	Sp. dori de Beurmann and Gougerot 1906.
	Sp. gougeroti Matruchot 1910.
	Sp. jeanselmei Brumpt and Langeron 1910.
	Sp. indicum Castellani 1908.
	Sp. asteroïdes Splendore 1909.
	Sp. lesnei Vuillemin 1910.

Sporotrichum schenki Hektoen and Perkins 1900.

Synonyms.—*Sporothrix schenki* Hektoen and Perkins 1900, *Rhinocladium beurmanni* Verdun 1913.

Discovered by Schenk in a case of gummatous lymphangitis in 1896 in North America. Easily grown on glucose, maltose, and other sugar media. Optimum temperature 30° to 38° C. Growth with an irregular surface, generally of white colour, but old cultures may present some brownish or black pigmentation. Glucose gelatine is slowly liquefied. Mycelial threads as a rule not very straight, rather bent, curved, or undulating; they are about 2 μ in diameter. Conidia present in small numbers, oval, supported by short sterigmata. Ferments lactose; has no action on saccharose.

Pathogenicity.—It is the cause of Schenk's sporotrichosis, found in North America. According to de Beurmann, this fungus is very little or non-pathogenic to rats and mice.

Sporotrichum beurmanni Matruchot and Ramond 1905.

Synonym.—*Rhinocladium beurmanni* Verdun 1913.

Discovered by de Beurmann in France, and completely investigated by himself and Ramond, Gougerot, Dor, Sicard, Pinoy, etc., in that country; by Adamson in England; by Lutz and Splendore in South America; by Carougeau in Madagascar, etc.

FIG. 417.—SPOROTRICHUM BEURMANNI MATRUCHOT AND RAMOND. (After Gougerot.)

Parasitic Life.—In the tissues oval, yeast-like or short bacillary forms are seen, 3 to 5 μ in length and 2 to 3 μ in breadth, free or engulfed by phagocytes. Pinoy has described some minute oval forms the shape and size of piroplasmata inside the macrophages In a case of general infection he has made the important observation that typical fructifications may be seen in the blood capillaries.

Cultures.—The best media are Sabouraud's maltose agar and glucose agar. The growth begins to appear between the fourth and the twelfth day. Optimum temperature 22° C. The growth may be whitish at first, but soon becomes completely black or of a brownish chocolate-like colour. The surface is cerebriform. Glucose gelatine is slowly liquefied. Mycelial threads about 2 μ in diameter, rather straight. Conidia oval, 5 to 6 μ in length and 3 μ in breadth, supported by short sterigmata. In contrast to *Sp. schenki*, the conidia are extremely numerous.

Ferments saccharose; has no action on lactose.

Pathogenicity.—Is the cause of by far the greatest number of cases of sporotrichosis in Europe (see Chapter LXIV.). Is very pathogenic to rats and mites.

Sporotrichum dori de Beurmann and Gougerot 1908.

Found by Dor in a case of gummatous sporotrichosis. In contrast to the typical *Sp. beurmanni*, the growth on maltose and glucose agars is slower; the colonies do not coalesce into a large mass, but remain separate and small, not exceeding 1½ millimetres in diameter. The colour is light brownish; never becomes black. Does not grow on gelatine. The mycelial filaments are very thin (0·5 to 1 μ), with short mycelial segments, occasionally dichotomous.

The fungus is not pathogenic, or very slightly so, for rats and mice.

Sporotrichum gougeroti Matruchot 1910.

Synonym.—*Rhinocladium gougeroti* Verdun 1913.

Differs from the typical *Sp. beurmanni* only in small details, the principal ones of which are the black pigmentation of the colonies from the very beginning, and the extremely abundant sporulation.

Sporotrichum indicum Castellani 1908.

Found by Castellani in Ceylon. It is doubtful whether it is a separate species, or merely a variety of *Sp. beurmanni*. The mycelial threads are often somewhat larger (2 to 3 μ wide) ; conidia roundish (3 to 5 μ) or oval (4 to 5 μ long and 3 to 4 μ in breadth). The colonies on maltose and glucose agars may be of various colour—white-greyish, light brownish, dark brownish, black.

Sporotrichum jeanselmei Brumpt and Langeron 1910.

Was isolated by Jeanselme and P. Chevallier from a case of gummatous sporotrichosis, and was studied botanically by Brumpt and Langeron. It differs from *Sp. beurmanni* by the mycelial filaments being thinner. These are septate, ramified with short lateral branches supporting clusters of spores. The spores are oval or roundish 2·5 to 3·5 μ.

Sporotrichum astercïdes Splendore 1909.

Synonym.—*Rhinocladium asteroïdes* Verdun 1913.

Discovered by Splendore in South America. Is characterized by the presence in the infected tissues of spherical bodies, 4 to 12 μ in diameter, from which some bacillary-like formations radiate. The fungus grows well on maltose and glucose agars,

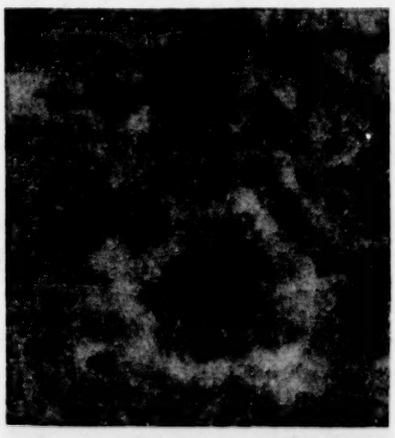

FIG. 418.—SPOROTRICHUM ASTEROÏDES SPLENDORE IN THE TISSUES.

Note radiate body.

1. 2.

FIG. 419.—SPOROTRICHUM ASTEROÏDES SPLENDORE.

1, Young culture; 2, old culture.
(From photographs by Dr. Splendore.)

the colonies being first white and later black. Pathogenic to man, rats and mice.

Sporotrichum lesnei Vuillemin 1910.

Synonym.—*Rhinocladium lesnei* Vuillemin 1910.

Differs from all the other species of *Sporotrichum* by the elongated shape and large dimensions of the conidia, which are 4 to 11 μ in length and 2·5 to 4 μ in breadth. Old cultures are of a dark sooty hue, and black chlamydospores may be present.

Genus Trichosporum Behrend 1890.

These fungi live parasitic on the surface of the hairs, but do not penetrate into their interior; during their parasitic life they vege-

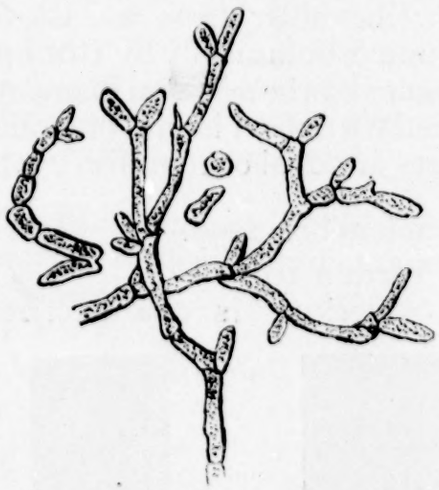

FIG. 420.—TRICHOSPORUM. (After Vuillemin.)

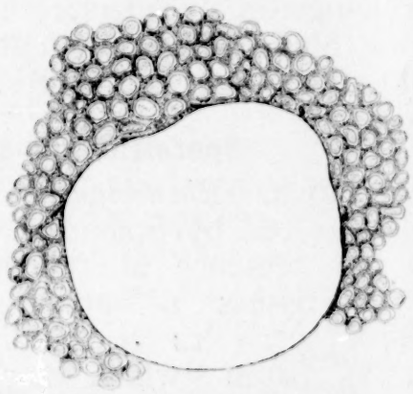

FIG. 421.—TRANSVERSE SECTION THROUGH A PIEDRA NODULE.

tate in the shape of large oval or roundish elements, embedded in an amorphous substance. Saprophytically (cultures) they vegetate, forming mycelial threads and spores.

Trichosporum giganteum Behrend 1890.

This is the cause of *piedra* of Columbia; develops on the surface of the hair in the shape of large polyhedric cells 12 to 15 μ in diameter. Masses of the fungus form hard nodules along the hair. The fungus is easily grown on various media. In cultures the mycelial threads are septated, cylindrical, between 1 and 4 μ wide The spores are of various dimensions, between 2 and 12 μ. The colour of the colonies is light brownish. Horta describes in the nodules of a variety of piedra certain large cyst-like bodies containing generally eight fusiform bodies. When the membrane burst, these bodies escape, being provided with one flagellum at each end. Pinoy is inclined to consider these formations to be asci containing ciliated ascospores.

Trichosporum beigeli Rabenhorst 1867.

Synonyms.—*Pleurococcus beigeli* Rabenhorst 1867, *Sclerotium beigelianum* Hallier 1868, *Hyalococcus beigelii* Schroeter 1886, *Chlamydotomus beigelii* Trevisan 1889, *Micrococcus beigelii* Migula 1900, *Trichosporum beigelii* Vuillemin 1901.

This fungus has been found in Europe several times in nodosities of the hairs of the moustache. It lives parasitically under the form of ovoid or polyhedral elements massed together on the surface of the hair. These ovoid or polyhedral elements are much smaller than those of the preceding species, their maximum diameter varying between 3 and 4 μ. It is easily cultivated on ordinary media. In cultures mycelial threads are found, septate, slender (1·57 to 2 μ). In old cultures chlamydospores can be seen.

Trichosporum ovoides Behrend 1890.

Found by Behrend in the nodosities present on the moustache of a European patient; vegetates parasitically on the surface of the hair under the form of ovoid elements; 3 to 4 μ long and $1\frac{1}{2}$ to $2\frac{1}{2}$ μ wide. Grows easily on culture media; on potatoes the colonies are white, while the medium takes a brownish-black colour.

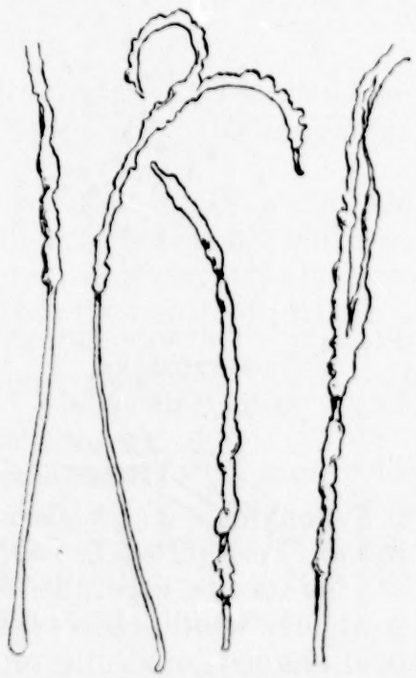

FIG. 422. — HAIR AFFECTED WITH TRICHOSPOROSIS. (After Vuillemin.)

Trichosporum ovale Unna 1896.

Found by Unna in the nodosities present on the moustache of a European patient. Very similar to *T. ovoïdes*: in cultures, however, the mycelial threads are often corkscrew-like, and the spores have thick walls.

On potatoes the colonies are white-yellowish, and the substratum takes a brownish-black colour.

Trichosporum glycophile du Bois 1910.

Found by du Bois in a nodular affection of the pubic hairs in a diabetic patient. In the nodules roundish elements, 3 to 4 μ, were present, together with a coccus. The fungus was easily cultivated in symbiosis with the coccus on sugar media.

Genus Glenospora Berk and Curtis.

Polymorphic fungi. Mycelium septated, little ramified. Sporophores rather short, erected; may be absent. Conidia do not become detached from the mycelium.

Glenospora graphii Siebenmann 1889.

Synonyms.—*Graphium penicillioïdes* Hallier 1869, *Stemphylium polymorphum* Hallier 1869, *Verticillium graphii* Siebenmann 1889, *Glenospora graphii* Vuillemin 1912.

Mycelium at first white, later dark brownish. The filaments are septated, 2 to 3 μ in breadth, ramified. Fertile hyphæ are erected, often dichotomous or trichotomous, with terminal conidia, which are ovoid with a smooth surface, and of a greyish-brownish colour. It is easily grown on the usual laboratory media; gelatine is not liquefied. This fungus has been found in cases of otomycosis by Hassestein, Bezold, Siebenmann, etc., and in a case of keratomycosis by Morax and Pinoy.

Genus Trichothecium Link 1824.

Fertile hyphæ are erect, grouped together, each terminating in an oval, pear-shaped, or globular conidium. The only species so far observed in man is *Trichothecium roseum*.

FIG. 423.—PITYROSPORUM OVALE BIZZOZZERO.
(After Sabouraud.)

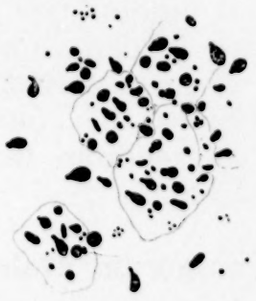

FIG. 424.—PITYROSPORUM OVALE BIZZOZZERO.
(After Sabouraud.)

Trichothecium roseum Persoon 1801.

Synonyms.—*Trichoderma roseum* Persoon 1801, *Sporocephalum roseum* Persoon 1801, *Puccinia rosea* Corda 1837.

This species vegetates on decaying vegetable matter; the colour is at first white, then pinkish. Each fertile hypha terminates in a pear-shaped conidium, 10 to 20 μ in length and 8 to 12 μ in breadth.

This fungus has been found in cases of otomycosis by Stendener, who did not succeed in cultivating it. Some authorities believe it to be identical to *Glenospora graphii*.

Genus Pityrosporum Sabouraud 1895.

Oval or roundish cells, somewhat yeast-like; no mycelium; cannot be grown artificially.

Pityrosporum ovale Bizzozzero 1882.

Synonyms.—*Saccharomyces ovalis* Bizzozzero 1882, *Pityrosporum malassezi* Sabouraud 1895. Usual term: bottle bacillus of Malassez.

This organism was first described by Bizzozzero, who considered it to be a *Saccharomyces*. Malassez and Sabouraud associated this organism with the ætiology of pityriasis simplex capitis and pityriasis alba.

Its shape somewhat resembles a budding yeast or a flask. The size varies greatly; the maximum diameter of some individuals may be as much as 10 to 15 μ, but much smaller forms (3 to 5 μ) are found.

Pityrosporum cantliei Castellani 1908.

Synonym.—*Saccharomyces cantliei* Castellani 1908.

Somewhat similar to *Pityrosporum ovale*, but the cells are generally roundish and on the average larger (5 to 16 μ). Probably the cause of a variety of seborrhœa of the scalp occasionally met with in children in the tropics.

Genus Malassezia Ch. Robin 1853.

Mycelium of various shape and size; non-ramified; spores collected in bunches like grape-bunches; only the parasitic stage known.

Malassezia furfur Ch. Robin 1853.

Synonyms.—*Microsporon furfur* Ch. Robin 1853, *Sporotrichum furfur* Saccardo 1886, *Malassezia furfur* Baillon 1889, *Oidium furfur* Zopf 1890, *O. subtile* Kotliar 1892.

Mycelium abundant, septate, non-ramified; some mycelial threads are much larger than others; the breadth varies between 3 and 4 μ. The spores are roundish (3 to 5 μ in diameter), and run into clusters.

Attempts at cultivation have failed. It is the cause of pityriasis versicolor.

Malassezia tropica Castellani 1905.

Synonym.—*Microsporon tropicum* Castellani 1905.

Mycelial threads generally thick (3 to 5 μ wide), with numerous swellings, constrictions, and other irregularities of shape; spores roundish (4 to 5 μ), with a double contour; are often collected in clusters. The fungus does not grow on artificial media. It is the cause of tinea flava or pityriasis flava of tropical climates.

Genus Cladosporium Link 1837.

Conidiophores of a greenish colour, with roundish or oval spores. These in hanging-drop cultures may appear as arranged in strings, but cannot become dissociated.

Cladosporium mansoni Castellani 1905.

Synonyms.—*Microsporon mansoni* Castellani 1905, *Foxia mansoni* Castellani 1908, *Cladosporium mansoni* Pinoy 1912.

The fungus is found very abundantly in the lesions of tinea nigra; the mycelial articles are rather short—18 to 20 μ in length and 2½ to

FIG. 425.—MALASSEZIA TROPICA CASTELLANI.
(From a fresh preparation in liquor potassæ. Old case.)

FIG. 426.—CLADOSPORIUM MANSONI CASTELLANI.
(From a fresh preparation in liquor potassæ. The mycelial tubes are in reality not so regular in outline as in this drawing.)

$3\frac{1}{2}$ μ in breadth ; non-ramified. Sometimes they may be irregular in outline, bent, banana-shaped. The spores are globular, and most of them very large—5 to 10 μ. They are frequently arranged in clusters.

The fungus is easily cultivated by inoculating scrapings of the affected patches on maltose agar. After two to four days roundish hemispheric colonies appear, which are black, but at first have usually a greenish tinge, and may present at the periphery some radiating, delicate, pale greenish hyphæ. These colonies may remain separate or more often gradually coalesce into a jet-black knobby mass, deeply rooted into the medium.

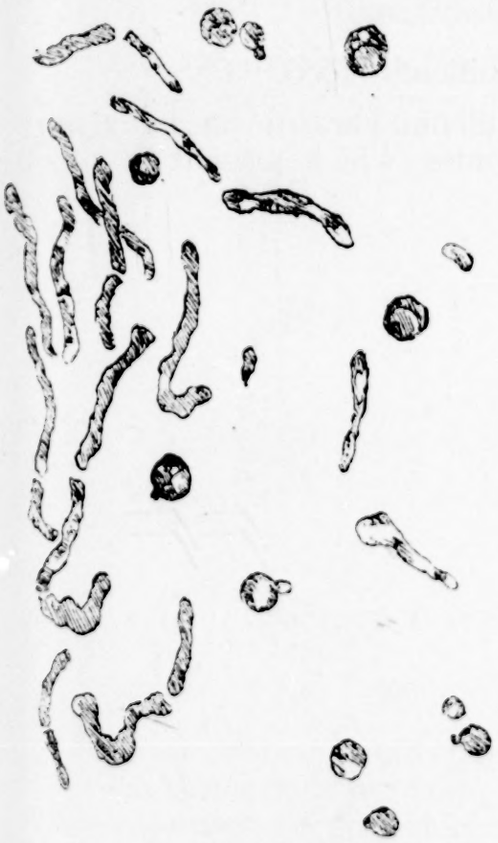

FIG. 427.—CLADOSPORIUM MANSONI CASTELLANI.
(From a preparation stained with fuchsin.)

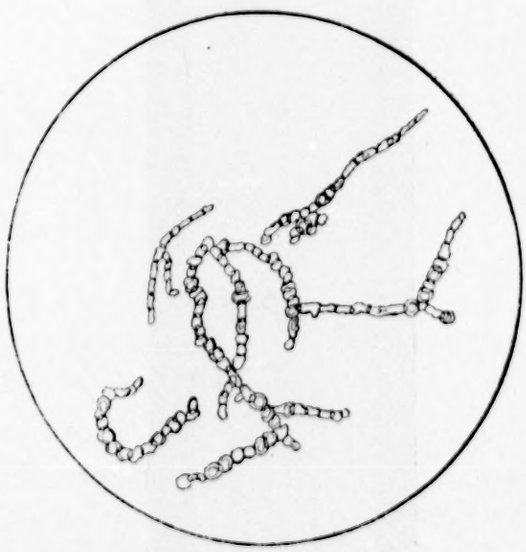

FIG. 428. — CLADOSPORIUM MANSONI CASTELLANI: HANGING-DROP CULTURE.

The fungus grows well, though less abundantly, on the other sugar agars, and also on ordinary agar. In *broth* and *peptone-water* the growth is very slow, and takes place at the bottom of the tubes, with formation of a black or greenish-black sediment. Gelatine is very slowly liquefied.

The *optimum temperature* for the growth of the fungus is between 30° and 32° C. ; above 35° C. and under 25° C. the growth is much slower, and may be nil under 20° C.

This fungus is the cause of tinea nigra.

Cladosporium madagascarienses Verdun 1912.

Found by Fontoynont in a patient with some ulcerated nodules of the leg in Madagascar. The fungus grows easily on Sabouraud's

and other media, giving rise to black cerebriform colonies. In hanging-drop cultures shows the typical features of the genus.

Cladosporium herbarium Persoon has been demonstrated by Nassee to be the cause of the black spots so often found on imported frozen meat.

Genus **Hemispora** Vuillemin 1906.

Mycelial filaments thin, hyaline, septated, ramified. Each conidiophore terminates into an ampulliform structure (proto-conidium), which later divides into several spore-like segments (deutero-conidia).

Hemispora stellata Vuillemin 1906.

Common in nature. Found by Vuillemin parasitic on *Aspergillus repens*, forming white roundish colonies, which present in relief

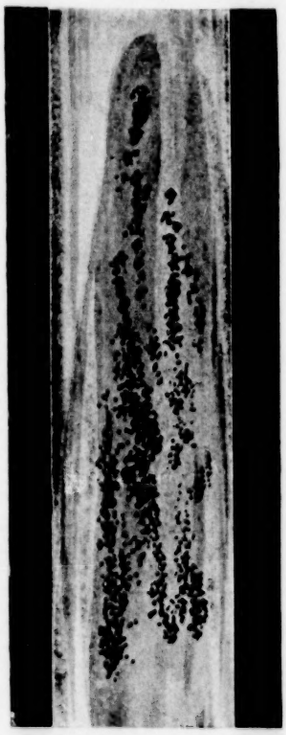

FIG. 429.—CLADOSPORIUM MANSONI CASTELLANI: YOUNG AGAR CULTURE.

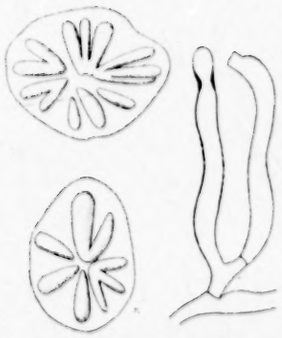

FIG. 430.—HEMISPORA STELLATA VUILLEMIN. (After Vuillemin.)

stellar or marguerite-like brown patches. Cultures on the usual laboratory media do not show anything characteristic, the growth being cerebriform of a yellowish-brownish colour.

Pathogenicity.—May cause gummatous and purulent lesions in man, as noted by Gueguen, Gougerot, de Beurmann, and Clair.

Genus **Enantiothamnus** Pinoy 1911.

Conidia have a verticillar disposition, and are situate at the septa which separate the mycelial segments.

Enantiothamnus braulti Pinoy 1911.

This fungus was discovered by Brault in some nodules on the gluteal region of an Arab, and was completely investigated botanically by Pinoy. In the lesions mycelial threads were present, septate, 1 to 3 μ in breadth. On Sabouraud's agar the colonies are white with the central portion yellowish. The characteristic feature is the presence of conidia in a verticellar arrangement at the mycelial septations. The fungus is pathogenic to the guinea-pig.

Genus Scopulariopsis Bainier.

Thin mycelial threads (0·5 to 1·5 μ) are septated; colourless. Conidiophores erect, each terminating into a tapering structure, which

FIG. 431. — ENANTIOTHAMNUS BRAULTI PINOY.
(After Brault and Pinoy.)

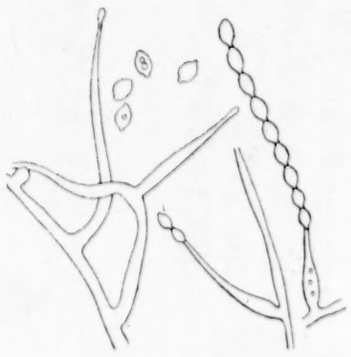

FIG. 432.—SCOPULARIOPSIS BLOCHI MATRUCHOT.
(After Vuillemin.)

supports a chain of ovoid spores. In very old cultures some peculiar whitish formations are seen, which, according to some authorities, may represent uncompletely developed perithecia.

Scopulariopsis blochi Matruchot 1911.

Synonyms.—*Mastigocladium blochi* Matruchot 1911, *Scopulariopsis blochi* Vuillemin 1911.

Found by Bruno Bloch in a case of gummatous lymphangitis, clinically very similar to an ordinary case of sporotrichosis. In cultures the mycelial threads are slender (0·5 to 1·5 μ in breadth), colourless, septated, very little ramified. Conidiophores, 20 to 30 μ in length, are tapering, and from the pointed ends chains of conidia take origin. Conidia elongated, ovoid, 3 to 4 μ in length and 1·5 to 2 μ in breadth. In old cultures white-creamy formations may be seen, which may possibly be undeveloped perithecia.

Scopulariopsis koningii Oudemans.

Synonyms.—*Monilia koningii* Oudemans, *Scopulariopsis rufulus* Bainier, *S. koningii* Vuillemin 1912.

A scopulariopsis isolated by Yanin in a case of subcutaneous gummata has been identified by Vuillemin as *S. koningii* Oudemans. The cultural characters are very similar to those of the previous species, but the peculiar white-creamy formations as observed in old cultures of *S. blochi* are not seen.

Genus Acremonium Link 1809.

Mycelial threads septate, little ramified. Sporophores tapering; each supports a terminal ovoid or elongated colourless spore.

Acremonium potronii Vuillemin 1911.

Found by Potron and Noisette in a case of subcutaneous gummata with fever, somewhat resembling typhoid before the gummata appeared. Easily grown on Sabouraud's agar; colonies white, then pinkish, and, later, orange-yellow. Serum is liquefied.

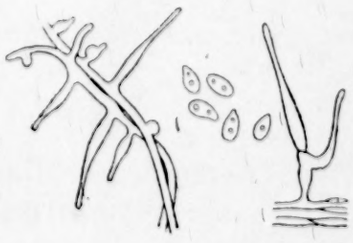

FIG. 433.—ACREMONIUM POTRONII VUILLEMIN.
(After Vuillemin.)

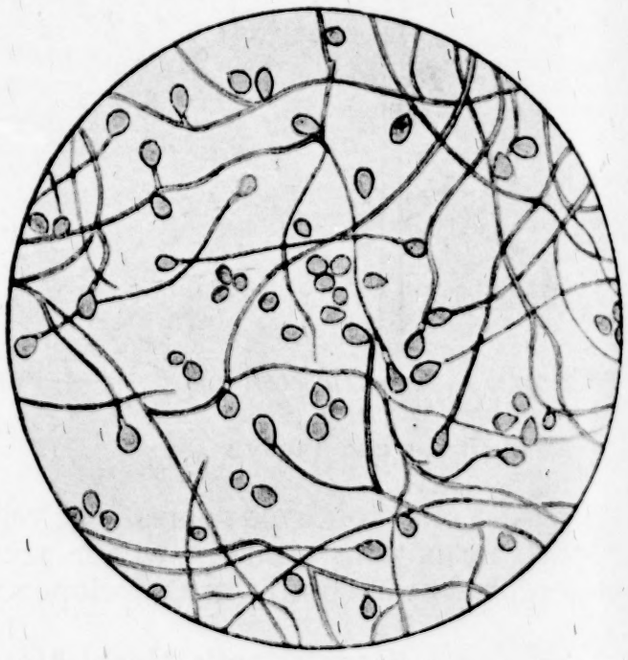

FIG. 434.—MONOSPORIUM APIOSPERMUM SACCARDO.
(After Radaeli.)

In cultures the mycelial filaments are septated; numerous conidiophores are present of a peculiar elongated type, 15 to 20 μ in length. Conidia ovoid, with a smooth surface, 4 to 5 μ in length and 2 to 2·2 μ in breadth; of pinkish colour. This fungus is pathogenic to guinea-pigs.

Genus Monosoprium Bonord and Saccardo 1898.

Mycelial filaments septated; conidiophores not erected, and each of them supports a terminal oval spore.

Monosporium apiospermum Saccardo 1911.

Easily grown, the cultures are whitish and covered with duvet ; may become brownish when old.

Mycelial tubes septated and of various size ; may reach 4 to 5 μ in breadth. Each conidiophore supports a terminal spore, which is either ovoid, 12 to 14 μ in length, and 5 to 6 μ in breadth, or roundish, 6 to 7 μ in diameter. No other kind of fructification is seen.

Pathogenicity.—This fungus has been found in Italy in cases of mycosis of the foot resembling madura foot, by Tarozzi and Radaeli. Tarozzi considered the fungus to be a *Nocardia*, while Saccardo and Radaeli have found it to be a new species of the genus *Monosporium*. Radaeli has made a complete pathological and clinical investigation of the condition.

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CHAPTER XLVIII

THE RARER PROTOZOAL INFECTIONS

Histoplasmosis—Rhinosporidiosis—The Sarcosporidioses—Onyalai—References.

Remarks.—In this chapter we group three general protozoal diseases with another general disease of unknown causation.

HISTOPLASMOSIS.

Definition.—Histoplasmosis is an acute specific infection caused by *Histoplasma capsulatum* Darling.

History.—This disease has been described by Darling, who also found the parasite, but being first discovered post mortem, the clinical signs are rather deficient. The first case was in a negro who, three months previously, had come from Martinique to the Canal zone of Panama.

Ætiology.—The disease is caused by the parasite *Histoplasma capsulatum* Darling, already described in the chapters on Protozoa. (*vide* p. 367).

Pathology.—The parasite infects epithelial and endothelial cells of the lungs, liver, and spleen. It also exists free in these organs. In the lungs it gives rise to pseudo-tubercles resembling miliary tubercles.

Morbid Anatomy.—In the first case there were ecchymoses and small nodules beneath the visceral pleura of both lungs, which was studded throughout with pale grey hyaline and miliary tubercles, 2 to 3 millimetres in diameter, while the remainder of the organs were of a bright red colour. The peribronchial glands were full of soft caseated tubercles. The heart was small, but normal. The liver was enlarged, pale, and in a condition of slight atrophic cirrhosis. The spleen was enlarged to about three times its usual size, very firm, with distinct Malpighian bodies. The kidneys were slightly cirrhotic; the pancreas, bladder, bone-marrow, and brain were normal, and no tubercle bacilli could be found.

Microscopically the lung tubercles were found to consist of alveoli, the walls of which were broken and collapsed, and were filled with alveolar epithelial cells distended with parasites. In the

liver the hepatic cells and the vascular endothelial cells were much infected with parasites. Some areas which stained badly were found to consist simply of the débris of cells with numerous parasites. The spleen showed intracellular and free parasites.

Symptomatology.—The symptoms closely resemble those of Indian kala-azar, there being irregular fever with enlargement of the spleen and liver, and severe anæmia with marked leucopenia.

Treatment.—Nothing is known as to the treatment or prophylaxis.

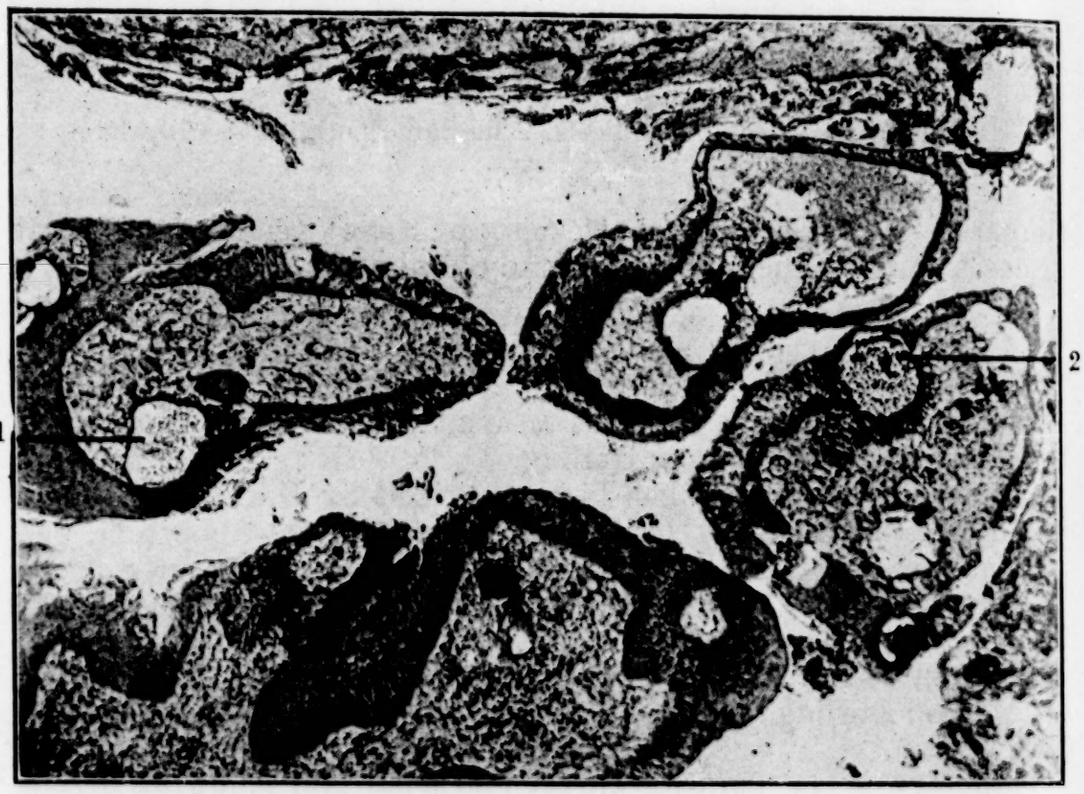

FIG. 509.—SECTION OF NASAL POLYPUS SHOWING RHINOSPORIDIUM SEBEERI AT 1 AND 2. (× 30.) CEYLON CASE.

1 is reproduced much more highly magnified in Fig. 149, p. 437.

(Microphotograph.)

RHINOSPORIDIOSIS.

Definition.—Rhinosporidiosis is a chronic infection caused by *Rhinosporidium seeberi* Wernicke 1900, and characterized by the production of polypi on mucous membranes and papillomata on cutaneous surfaces.

History.—The disease was first recognized by Seeber in Buenos Aires, in a nasal polypus occurring in a young man aged nineteen years. In 1900 he gave a description of the parasite and its development, which we have been unable to obtain, but which is said to be a most excellent account. Later he found two other cases in the same town, and in 1900 the parasite was named *Coccidium seeberi* by Wernicke.

In 1903 Kinealy reported to the Laryngological Society a peculiar case of a polypus growing from the septum of the nose of an Indian in Calcutta in the form of a pedunculated, raspberry-like body, with whitish spots on the general red surface. On section this tumour was found to have peculiar bodies embedded in it. It was then carefully examined and described by Minchin and Fantham, who came to the conclusion that the peculiar bodies were Haplosporidians, and named them *Rhinosporidium kinealyi*. In 1905, Nair of Madras found similar nasal polypi in several people,

FIG. 510.—RHINOSPORIDIUM SEBEERI AS SEEN AT 2 IN FIG. 509. (× 300.)
CEYLON CASE.
(Microphotograph.)

who all came from the small native State of Cochin, on the west coast of India. These polypi were carefully described by Beattie in 1906.

In 1910 we observed the same parasite in a nasal polypus in Ceylon, and in the same year Ingram published an account of its occurrence in a conjunctival polypus and in a papilloma on the penis.

Climatology.—Rhinosporidiosis occurs in South America, in India, and in Ceylon, and quite possibly in other regions.

Ætiology.—The causation of the disease is the presence of *Rhinosporidium seeberi* Wernicke 1900 (*vide* p. 437).

Morbid Anatomy.—The nasal tumours are usually covered with stratified pavement epithelium, which sends prolongations into the deeper tissues, in which there is an active cellular proliferation. In this connective tissue the parasites may be seen.

Pathology.—The parasite spreads in the body by the rupture of the cyst and the liberation of the spores. We suspect that it may, at times, give rise to a condition resembling a septicæmia.

Symptomatology.—The patient has his attention drawn to his nose by profuse bleedings, and in a little time notices a growth. On examination this is found to be a small vascular pedunculated tumour, about the size and shape of a pea, freely movable and painless, attached to the anterior and upper part of the cartilaginous septum. In appearance it resembles a strawberry or a raspberry.

It may, however, form polypi in other regions, as, for example, on the conjunctiva or papillomata on cutaneous surfaces, as, for example, on the penis.

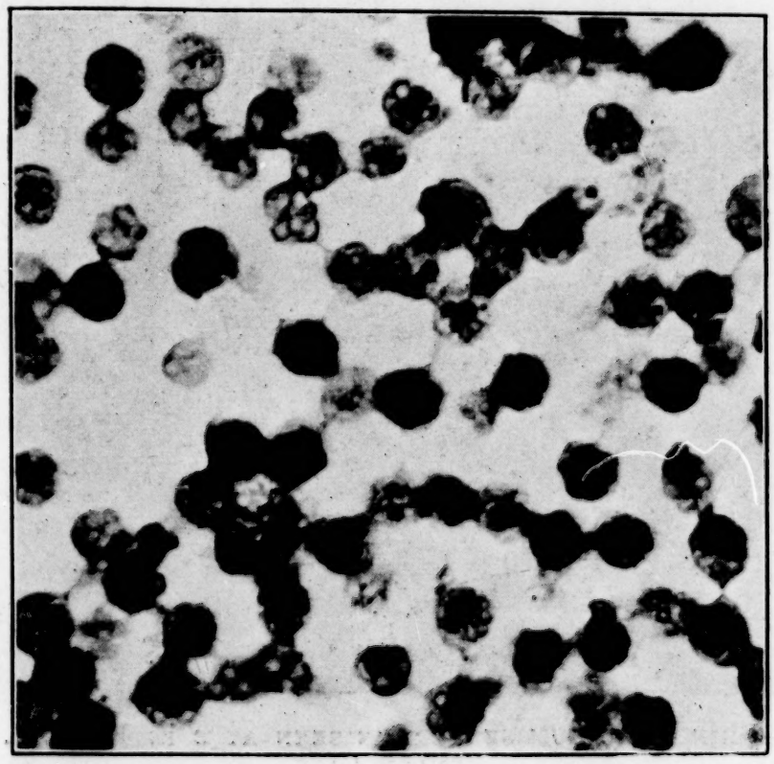

FIG. 511.—RHINOSPORIDIA SEBEERI AS SEEN AT 2 IN FIG. 509. (× 1,000.)
CEYLON CASE.
(Microphotograph.)

Diagnosis.—The diagnosis can only be made by removal of the whole or a portion of the growth, which in most cases has the appearance of a nasal polypus, followed by a microscopical examination, when the parasite will be easily seen as a roundish cyst filled with granules which, when examined under a higher power, are seen to be the pansporoblasts.

Prognosis.—This is usually said to be good, but if it can cause, as we suspect, a general infection, it may be dangerous to life.

Treatment.—The treatment is to remove the growth and cauterize its base.

Prophylaxis.—As we are entirely ignorant of the life-cycle of the parasite or where it exists outside the human body, no remarks can be made as to the prophylaxis.

THE SARCOSPORIDIOSES.

Definition.—Sarcosporidiosis is a chronic infection caused by the invasion of the body by *Sarcocystis lindemanni* Rivolta 1878, *Sarcocystis muris*, and perhaps other allied organisms.

History.—In 1868 Lindemann found some indefinite bodies in the myocardium and on the valves of the heart of a person who had died of dropsy. It is thought that these bodies may possibly have belonged to the genus Sarcocystis, but it is very doubtful what they really represented. In 1887 Koch described the first genuine case in Egypt. In 1894 Baraban and St. Remy found these parasites in the laryngeal muscles of a man who had been executed. In 1902 Rosenberg reported a doubtful case, and Kartulis another doubtful case. In 1903 Et. and Ed. Sergent described a parasite which later was called *Sergentella hominis* Brumpt 1910 in the blood (*vide* p. 441), and in 1905 Castellani and Willey described rather different bodies also in the blood (*vide* pp. 441 and 442), which they were inclined to consider of protozoal origin, and later similar, but somewhat larger forms, were found by Castellani and Sturgess in the blood of *Bos indicus*. In 1909 Darling described a case of sarcosporidiosis in a Barbadian negro in which the parasite appeared to be *Sarcocystis muris*.

Climatology.—Sarcosporidiosis being only a chance infection in man, and the parasite normally occurring in monkeys, buffaloes, cattle, sheep, pigs, rats, and other animals, it is obvious that not merely will the disease be very widespread, but that different varieties will occur in the different zoological regions. The cases so far described are in Central America, Europe, and Egypt, and doubtful cases in Algeria and Ceylon. We are suspicious that the Ceylon case may have some connection with *S. tennellæ—var. bubalis* Willey, Chalmers, and Philip 1904, which is very commonly found in buffalo meat in Ceylon.

Ætiology.—The causation of sarcosporidiosis is the presence of some species of sarcocystis in man, but the method of entry is not obvious. It would seem possible that eating undercooked meat infected with *Sarcocystis* might produce the infection, as Darling has shown that guinea-pigs can be infected by feeding them with rat's muscle containing *S. muris*, and by feeding them with the ripe sporozoites of the same species. In our opinion this is a very probable method of chance infection, because the buffalo meat in Ceylon is heavily infected (*vide* p. 435).

Morbid Anatomy.—The spores can be found in the blood and the parasites in the muscle fibres.

Symptomatology.—The incubation period in animals appears to be very long, some 152 to 164 days. During the invasion the patient suffers from an irregular fever, which may resemble enteric fever, and in severe cases this fever may be complicated with myositis and even necrosis of the muscles.

Diagnosis.—The symptoms are those of an irregular fever, which in some cases may be typhoidal-like, and in others of a very low

type without much general disturbance, while some cases may never show pyrexia. The nature of these fevers may be suspected by finding bodies resembling the spores of *Sarcocystis* (*vide* Fig. 148, p. 435) in the blood. Failing this, and especially if there are any signs of myositis, the diagnosis can be cleared by excision and examination of a piece of diseased muscle.

Prognosis.—This is good after the parasites have become quiescent, for no one has so far been known to die of the disease.

Treatment.—The treatment is entirely symptomatic.

Prophylaxis.—Meat should be carefully inspected, and any found heavily infected with *Sarcocystis* should be condemned, while all meat should be well cooked.

SERGENTELLIASIS.

The brothers Sergent, in 1903, described a peculiar parasite (the description of which is found on p. 441) in a person suffering from night sweats and attacks of nausea. There was apparently no fever, and the general condition was good. This parasite, to which Brumpt has given the name of *Sergentella hominis*, might be the free spores of a species of *Sarcocystis*.

ONYALAI.

Synonyms.—Edyuo (Bukoba) ; Kafindo (Congo).

Definition.—An acute infectious disease of unknown causation, characterized by the appearance of bullæ containing blood on the surface of the body, the tongue, soft palate, or buccal mucous membrane.

History.—The disease was discovered by Yale Massey in Angola in 1904, and fully described by Wellman later in the same year in Portuguese West Africa, and by Feldman, in 1905, in East Africa, where it is called ' edyuo ' by the natives of Bukoba. Mense (1906) thinks that the ' kafindo ' disease of the Unyamwezi people of the Congo is the same disease. Hæmorrhagic bullæ in the mouth, but without general symptoms, have been described by Maxwell in Changpo, South China, as being due to the accidental introduction into the mouth of a kind of spider's web.

Ætiology.—This is unknown, but Wellman considers that it is not a manifestation of malaria ; nor is it a vegetal poisoning, nor a snake-poisoning, though the bite of *Bitis arietans*, the puff-adder, simulates some cases closely. Neither trypanosomes nor bacteria were found. It is not a purpura hæmorrhagica, nor Henoch's purpura, nor Schönlein's disease. Mense thinks it may be some kind of poisoning, perhaps with some species of the Euphorbiaceæ.

Symptoms.—The onset is sudden, and is accompanied by lassitude and a dazed appearance. Sometimes the parotids are tender, and the eyes may be somewhat reddened, and in about 66 per cent. of cases there is a slight rise of temperature. Numbness and pain in various parts of the body may be noted.

The appetite is poor; bullæ may be seen on the tongue and in the mouth and pharynx, while they also occur in the œsophagus, stomach, and bowels. The tongue is swollen and painful. Vomiting of blood is not rare, and bloody diarrhœa may take place. Hæmaturia has been noted, and cerebral hæmorrhage, with the usual signs, has been seen. It is believed that hæmorrhage into the pancreas, liver, and spleen, may take place in some cases. Bullæ may also appear in the skin, ranging from the size of a split pea to several inches in diameter. The typical bullæ, whether on a mucosa or in the skin, extend deeply, involving the submucosa or the corium, and are crossed by fibrous trabeculæ, in the meshes of which lies partially coagulated blood, which appears dark through the skin or mucosa. The red corpuscles are not disintegrated, and can be seen by the microscope.

The disease is said to have a tendency to recur two or three times.

Diagnosis.—The diagnosis from snake-bite may be effected only by the history, as the bullæ may not be visible on the skin or mucosa. Malaria can be excluded by the blood examination. Schönlein's disease, or peliosis, is diagnosed by the rash, painful swelling of the joints, and the purpuric eruption. Henoch's purpura is met with generally in children, and has joint symptoms, as well as a rash.

Prognosis.—Wellman reports three deaths in fourteen cases, and says that the malignancy varies in different seasons and districts.

Treatment.—Wellman thinks that arsenic in full doses is the best treatment. He says the natives use empirically *Geigera wellmani* Hutch and *Albizzia anthelmintica* A. Broga. Massey recommends large doses of bicarbonate of soda and cod-liver oil.

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irregular. The physical examination of the chest reveals very little except a few dry or coarse moist râles. The general condition may remain fairly good for a long time, though a certain degree of anæmia is often present. A few cases waste rapidly.

The course of the disease is very prolonged, the first case observed by one of us in 1904 being not merely still alive in 1913, but practically cured.

Diagnosis.—The acute type is generally mistaken for influenza or malaria. The examination of the sputum in which no Pfeiffer's bacilli are found will distinguish the affection from influenza, and the examination of the blood will exclude malaria.

Cases of the chronic type presenting blood in the expectoration are generally diagnosed as phthisis. The examination of the sputum for tubercular bacilli will be always negative, and the animal inoculations will remain without effect. The ophthalmo- and cuti-reactions are negative in the great majority of cases.

Occasionally, however, cases of mixed infections of tuberculosis and spirochætosis occur, one such case being described by Branch.

Spirochætosis is easily distinguished from endemic hæmoptysis by the examination of the sputum, which will show absence of the ova of *Paragonimus westermani*, and from bronchomycosis by the absence of fungi.

Prognosis.—The prognosis is favourable *quo ad vitam*, but the disease may take a chronic course with anæmia and wasting.

Treatment.—Treatment with the ordinary expectorant mixtures is unsatisfactory, but in chronic cases the glycerophosphates and arsenic give somewhat better results.

Prophylaxis.—Nothing can at present be said with regard to this.

TROPICAL BRONCHOMYCOSES.

General Remarks.—Affections of the bronchi and lungs due to fungi are common in the tropics, though very little attention has been paid to them till recently. These conditions may be due to a variety of fungi, belonging to the following genera :

1. Monilia Gmelin 1791.
2. Nocardia Toni and Trevisan 1898.
3. Aspergillus Micheli 1729, Sterigmatocystis Cramer 1869, Penicillium Link 1908.
4. Mucor Micheli 1729 and Rhizomucor Lucet and Costantin 1900, Lichtheimia Vuillemin 1904.
5. Sporotrichum Link 1889.
6. Undetermined fungi.

The symptoms are somewhat similar, whichever fungus is the ætiological factor. In mild cases there are signs of slight bronchitis with muco-purulent expectoration, in which the fungi are found.

In severe cases the patient presents all the symptoms of phthisis with hectic fever and hæmorrhagic expectoration.

Mild cases may get cured spontaneously; but they are often benefited by potassium iodide. We will describe in detail the form of bronchomycosis due to fungi of the genus *Monilia*, as this type is extremely common in Ceylon, and it has been possible to investigate it more completely.

FIG. 514.—FUNGUS FROM A CASE OF BRONCHOMYCOSIS (UNDETERMINED).

Bronchomoniliasis.

Synonyms.—Broncho-oïdiosis (Castellani); Broncho-endomycosis (Castellani); Bronchoblastomycosis.

Definition.—An infection of the bronchial mucosa due to fungi of the genus *Monilia* Gmelin 1791.

Historical.—In the tropics the condition has been studied by one of us, who since 1905 has published many cases, divisible into a mild type and a severe type of the disease, and has described several new species of *Monilia*.

Ætiology.—In Ceylon the malady is generally due to *Monilia tropicalis* Castellani 1910. The same fungus may be found in cases coming from South India and the Malay States. It would appear that the fungus is the real cause of the disease, as no other ætiological agents, such as the tubercle bacillus, etc., are found. Moreover, when the patient gets better, the fungus becomes very scanty or disappears completely. In some cases other species of the fungus may be observed, but it is doubtful whether all of these are really pathogenic. These species are *Monilia paratropicalis* Cast., *M. pinoyi* Cast., *M. guillermondi* Cast.,

M. negrii Cast., *M. nivea* Cast., *M. candida* Cast., *M. insolita* Cast., *M. pseudotropicalis* Cast., *M. lacticolor* Cast., *M. nitida* Cast., *M. lactea* Cast., *M. krusei* Cast., *M. rugosa* Cast. For the cultural characters of these species see pp. 822 and 823.

The infection may take place from man to man, and also probably by the fungi living saprophytically in nature. Monilia-like fungi are extremely common in Ceylon in tea-dust, and it is very probable that the so-called ' tea-factory cough ' is a type of moniliasis.

Symptomatology.—A mild and a severe type of the malady may be distinguished. In the *mild type* the general condition of the patient is fairly good, there is no fever, and he simply complains of cough. The expectoration is muco-purulent and very often scanty ; and no blood can be seen. The physical examination of the chest will reveal only a few coarse râles or absolutely nothing. The

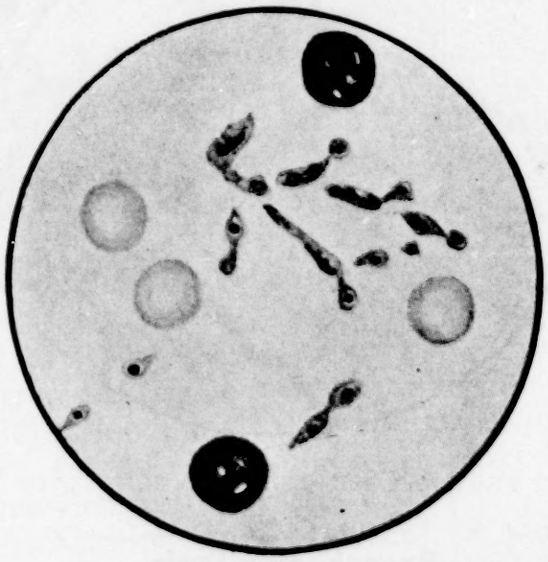

FIG. 515.—SPUTUM IN BRONCHOMONILIASIS (SEVERE CASE).
(From a preparation stained by methylene blue.)

condition may last several weeks or months, and may get cured spontaneously, or, continuing, may turn into the severe type. The *severe type* closely resembles phthisis : the patient becomes emaciated, there is hectic fever, muco-purulent and bloody expectoration. Occasionally true hæmoptysis occurs, a teaspoonful or more of bright blood being spat up at a time. The physical examination of the chest may show patches of dulness, fine crepitations, and pleural rubbing. This type is often fatal. Between these two extreme types there are of course cases of intermediate severity, apyretic or with subcontinuous and continuous fever and more or less marked bronchial and broncho-alveolar symptoms.

Diagnosis.—The diagnosis of moniliasis is based on finding the fungus in the sputum. It is absolutely necessary that this should be collected in sterile petri dishes and examined as soon as possible, as sputum exposed to the air becomes contaminated with all sorts

of fungi in the tropics. In fresh preparations of the expectoration spore-like, roundish, or oval cells 4 to 6 μ are seen, often presenting a double contour, alone or more rarely with some mycelial articles. The fungus is Gram-positive.

To identify the fungus cultural researches are necessary. A particle of the sputum is smeared on maltose or glucose agar plates ; after two or three days white, rather large, roundish colonies appear, easily distinguishable, even macroscopically, with a little practice, from the colonies of cocci and other bacteria. The fungus colonies are further investigated by inoculating maltose agar, ordinary agar, gelatine, serum, and a set of sugar broths. All the species of *Monilia* found in our cases grow well on ordinary agar, but much more abundantly on maltose and glucose agar, especially if slightly acid. On these media the growth, which is generally white with a smooth surface when young, slightly crinkled when old, is composed practically of globular, yeast-like cells, while in the water of condensation globular cells and mycelial elements are found together. A little mycelium may, however, be found also occasionally in the growth on the slope. For further details see pp. 822 and 823.

On serum all the strains produce at first a white growth, but some, later on, induce a peculiar brownish-black discoloration of the medium round the growth. Most species do not liquefy the medium.

On *gelatine* all the species grow fairly well ; a few, including *Monilia albicans*, produce liquefaction of this medium. In milk some do not produce either acid or clot, others produce a temporary or permanent acidity, others clot the milk or peptonize it. The reactions in the various sugar broths are important, and in association with the behaviour of the fungi on serum gelatine and milk, give the data on which to differentiate the various species (*vide* pp. 822 and 823).

Differential Diagnosis.—Primary bronchomoniliasis as described in this chapter should be distinguished from the secondary bronchomoniliasis occasionally met with in cachectic patients suffering from cancer, diabetes, tuberculosis, etc. In such cases there is generally thrush of the oral mucosa, and the thrush *Monilia* spreads to the pharynx, larynx, and bronchial mucosa, while in primary bronchomoniliasis the oral mucosa is not, as a rule, affected.

From pulmonary tuberculosis the condition is distinguished by the absence of the tubercle bacillus in the sputum and the negative animal inoculations. Cases of mixed infection, however—tuberculosis, and moniliasis—are occasionally met with, the sputum containing both the tubercle bacillus and the *Monilia* fungi.

From broncho-spirochætosis it is recognized by the absence of spirochætes, from endemic hæmoptysis by the absence of the ova of *Paragonimus westermani* Kerbert.

Prognosis.—The cases of a mild type may recover spontaneously or under appropriate treatment. Those of the severe type usually end fatally.

Treatment.—Mild cases and those of medium gravity respond quickly to potassium iodide (gr. x. to xx.) given well diluted in water or milk three times daily. When potassium iodide causes severe symptoms of iodism, saiodin in the same doses (in cachets) may be administered. In the cases of the severe type we have seen no improvement from the many different treatments adminis-

tered. Potassium iodide, however, should always be tried in these cases, as well as balsams. The diet should be nourishing; hypophosphites and glycerophosphates may be tried to keep up the strength of the patient, as in phthisis.

Tea-Factory Cough.

This affection, common in Ceylon, is probably a form of bronchomycosis. Coolies working in tea-factories are occasionally observed to deteriorate in their general health, losing flesh and becoming easily tired, at the same time they develop a cough with mucopurulent expectoration. The physical examination of the chest reveals nothing except occasionally a few coarse râles. If these coolies are taken away from the factory and sent to work in the fields, all the symptoms slowly disappear.

A similar affection may be observed in tea-tasters. Tea-tasters, in order to judge of the quality of teas, not only taste infusions, but frequently fill their hands with the leaves and bury their noses in them, snuffing them up; in this way a certain amount of tea-dust enters their nasal cavities, and with the tea-dust the microorganisms which are found in it. According to the researches of one of us, tea and tea-dust in Ceylon contain:—

1. Fungi of the genus *Monilia* constantly.
2. Fungi of the genus *Aspergillus*, *Sterigmatocystis*, and *Penicillium* frequently.
3. A peculiar *streptococcus*, somewhat different from *S. pyogenes*, frequently.

It is interesting to note that such germs are very rare or absent in samples of tea examined in England. The same organisms may be found, in Ceylon, in nasal cavities of tea-tasters; in their expectoration the *Monilia*-like fungi are practically constant, the *streptococci* very frequent, while *Aspergillus* and *Penicillium* fungi are rare. Guinea-pigs in whose nostrils tea-dust is daily insufflated for months, develop a broncho-alveolar moniliasis.

Bronchial Nocardiasis.

Synonym.—Bronchial streptomycosis.

This type of bronchomycosis has been studied by many investigators in Europe, among whom we may mention Foulerton, who has made a very complete study of the condition in England. One of us has observed two cases in Ceylon. The symptoms may closely resemble tuberculosis of the lungs. The sputum contains acid-fast rods, which closely resemble the tubercle bacilius, but are often longer, and the branching is much more definite. The subcutaneous inoculation of such sputum does not produce tuberculosis in guinea-pigs. Several species of *Nocardia* (*N. hominis* Foulerton, etc.) have been described, some of which are easily grown, others are grown with difficulty, and a few cannot be cultivated. The prognosis is bad, and the treatment unsatisfactory.

Bronchial Aspergillosis.

Synonyms.—Broncho-alveolar aspergillosis, Aspergillar pseudo-tuberculosis, Pneumomycosis of aspergillar origin.

Definition.—A form of bronchitis and broncho-alveolitis due to fungi of the genus *Aspergillus* Micheli 1723 and *Sterigmatocystis* Cramer 1859.

Historical.—The condition has been studied by Virchow, Lichleine, Dieulafoy, Chantemesse, Widal, one of us, Wise, and others.

Climatology.—The geographical distribution of the disease seems to be cosmopolitan. It is very common in certain parts of France. In the tropics we have seen some cases in Ceylon and Tropical Africa, and recently Wise has reported a case from British Guiana.

Ætiology.—The condition is due to fungi of the genus *Aspergillus* Micheli and *Sterigmatocystis* Cramer. It is common especially in people who have to handle various grains on which spores of those fungi are often found. In France it is extremely frequent among pigeon-breeders (*gaveurs de pigeons*), who fill their mouths with grain and blow it into the mouths of the pigeons.

It is probable that the deleterious effects caused by the fungi are due not only to a mechanical irritative action, but also to toxins secreted by the fungi.

Morbid Anatomy.—The lungs, and occasionally the liver, kidneys, and other organs, may show a type of pseudo-tuberculosis characterized by the presence of numerous mycotic tubercular-like nodules.

Symptomatology.—The presence of the fungi in the bronchi, when in small amount, may not give rise to any symptom. When the infection is heavy, symptoms of bronchitis with mucopurulent, and occasionally bloody, expectoration are present, and in severe cases the patient may have a serotive temperature, with sweatings and great wasting.

Diagnosis.—This is based on finding the fungus. It is to be noted that in the sputum as a rule only mycelial threads are found, and cultivations are therefore necessary.

Prognosis.—Mild cases often recover, but in severe cases with bloody expectoration the prognosis is bad.

Treatment.—A change of climate and, when the condition is brought about by certain occupations, a change of occupation is very beneficial. Potassium iodide (gr. xv. to xx.) may be administered.

Bronchial Penicilliosis.

One of us has observed cases of bronchitis and broncho-alveolitis due to fungi of the genus *Penicillium*.

The symptomatology, diagnosis, and treatment are the same as in Bronchial Aspergillosis.

Bronchial Mucormycosis.

Cases of bronchitis caused by fungi of the genus *Mucor* Micheli 1729, *Lichtheimia* Vuillemin 1904, *Rhizomucor* Lucet and Costantin 1900, *Rhizopus* Ehrenberg 1820 may be met with, but are of rare occurrence. The symptomatology is the same as that of Bronchial Aspergillosis.

Bronchial Sporotrichosis.

A few cases have been described of a bronchitis due to fungi of the genus *Sporotrichum* Link 1889.

Undetermined Bronchomycosis.

One of us has described cases of bronchomycosis due to fungi which have not yet been classed.

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CHAPTER L

DISEASES OF THE ALIMENTARY CANAL

General remarks—List of animal parasites—Diseases caused by animal parasites—Tæniasis—Strongyloidosis—Trichuriasis—Agchylostomiasis—Ascariasis — Oxyuriasis — Polyparasitism — Gordiaceiasis and Acanthocephaliasis—Diplopodiasis and Chilopodiasis—Gastro-intestinal Myiasis —Scoieciasis — The vomiting sickness of Jamaica—Earth-eating—Belyando spew—References.

GENERAL REMARKS.

THE diseases of the alimentary canal include a very large number of affections which are common to all parts of the world, and need not concern us here except to remark in passing on a few points. *Cancer* of the lips, cheeks, and tongue are frequently met with in Ceylon and other parts of the tropics. All forms of *dyspepsia* are common, but Marchoux and Brochet have specially called attention to the frequency of hyperchlorhydria and fermentation, which agrees with our own experience.

External hernia is common, but internal hernia is rare ; we have only met with one example, and then of a most unusual form, the displacement being through a rupture in the transverse mesocolon, forming a hernia into the lesser sac. This hernia probably took place through the recessus intermesocolicus transversa (Bröscke). *Intussusception* and *volvulus* are known, as well as intestinal obstruction due to bands, and we have met with one unique case of fatal intestinal obstruction in a native found dead, caused by the compression of the rectum against the pelvic wall by an enormously distended bladder, which we had not thought to be possible.

Cancer of the stomach and bowels is by no means uncommon, but *gastric ulcer* is rare, and we have only met with one case. *Tuberculosis* of the bowel is generally secondary to tuberculosis in some other regions, but we have seen primary tuberculosis. *Appendicitis* is quite common in both Europeans and natives, and is caused by bacteria acting either directly, or introduced by the action of *Trichuris* and *Ascaris*. Appendicitis of schistosomic origin has been recorded by Mursell.

We would also call attention to the frequency of *intestinal sand*.

CHAPTER LXIII

SKIN DISEASES (*continued*) —TROPICAL DERMATOMYCOSES

Tropical dermatomycoses—Tinea cruris—Tinea alba—Tinea albigena—Tinea sabouraudi—Tinea nigro-circinata—Tinea imbricata—Tinea intersecta—Tinea flava—Tinea nigra—Blastomycosis—Sporotrichosis—Aspergillosis—Pennicilliosis—Pinta—References.

TROPICAL dermatomycoses—that is to say, tropical skin diseases caused by fungi higher than bacteria—may be classified as follows:—

TROPICAL DERMATOMYCOSES.

I. Due to fungi of the genus *Epidermophyton* Lang 1879, *Trichophyton* Malmsten 1845, *Microsporon* Gruby 1843	*Ep. cruris* Castellani 1905, common variety of Tinea cruris (dhobie itch). *Ep. perneti* Castellani 1907, variety of Tinea cruris. *Ep. rubrum* Castellani 1909, variety of Tinea cruris. *T. nodoformans* Castellani 1911, variety of Tinea cruris. *T. macfadyeni* Castellani 1905, variety of Tinea alba. *T. albiscicans* Nieuwenhuis 1907, Tinea albigena. *T. blanchardi* Castellani 1905, Tinea sabouraudi tropicalis. *T. ceylonense* Castellani 1908, Tinea nigro-circinata. *T. soudanense* Joyeux 1912, variety of Tinea capitis. *T. violaceum* Bodin 1902, variety of Tinea capitis. *T. violaceum* Bodin 1902, *var. decalvans* Castellani 1911, variety of Tinea capitis. *T. polygonum* Uriburu 1909. *T. exsiccatum* Uriburu 1909. *Microsporon flavescens* P. Horta 1912, variety of Tinea capitis and corporis.
II. Due to fungi of the genus *Endodermophyton* Castellani 1909	*En. concentricum* Blanchard 1901, Tinea imbricata. *En. indicum* Castellani 1911, Tinea imbricata. *En. castellanii* Perry 1907, Tinea intersecta.
III. Due to fungi of the genus *Malassezia* Baillon 1889.	*M. tropica* Castellani 1905, Tinea flava.

IV. Due to fungi of the genus *Cladosporium* Link 1809	*C. mansoni* Castellani 1905, Tinea nigra.	
	C. madagascariense Verdun 1913, peculiar nodular affection.	
V. Due to fungi of the genera *Saccharomyces* Meyer 1838, *Cryptococcus* Kutzing, *Coccidioides* Rixferd and Gilchrist 1897, *Monilia* Gmelin 1791	Several species, some of which incompletely investigated	Varieties of blastomycosis.
VI. Due to fungi of the genus *Nocardia* Toni and Trevisan 1889	*N. minutissima* Burchardt 1859, erythrasma.	
	N. carougeaui Brumpt 1910, juxta-articular nodules.	
	N. tenuis Castellani 1912, trichomycosis axillarum.	
	N. thibiergei Pinoy and Ravaut 1909, nodular affection.	
	N. rivierei Verdun 1912, nodular affection.	
VII. Due to fungi of the genera *Sporotrichum* Link 1809, *Hemispora* Vuillemin 1906, *Enantiothamnus* Pinoy 1911, *Scopulariopsis* Bainier, *Cladosporium* Link 1809, *Acremonium* Link 1809	*Sporotrichum beurmanni* Matruchot and Ramond 1905	Varieties of sporotrichosis found in the tropics.
	S. shenki Hektoen and Perkins 1900	
	S. asteroïdes Splendore 1911	
	S. indicum Castellani 1908	
	Hemispora stellata Vuillemin 1906	Various types of gummatous affections.
	Enantiothamnus braulti Pinoy 1912	
	Scopulariopsis blochi Matruchot 1911	
	Cladosporium madagascariense Verdun 1913	
VIII. Due to fungi of the genera *Aspergillus* Micheli 1725, *Sterigmatocystis* Cramer 1869, *Madurella* Brumpt 1905, *Indiella* Brumpt 1906, *Nocardia* Toni and Trevisan 1889, *Sporotrichum* Link 1806, *Monosporium* Bonord and Saccardo 1898	*Aspergillus bouffardi* Brumpt 1906	Varieties of mycetoma.
	Sterigmatocystis nidulans Eidam 1883	
	Madurella mycetomi Laveran 1902	
	M. bovoi Brumpt 1910	
	M. tozeuri Nicolle and Pinoy 1906	
	Indiella mansoni Brumpt 1906	
	I. reynieri Brumpt 1906	
	I. somaliensis Brumpt 1906	
	Nocardia maduræ Vincent 1894	
	N. asteroïdes Eppinger 1890	
	N. pelletieri Laveran 1906	
	N. bovis Harz 1877	
	N. israeli Kruse 1896	
	Sporotrichum beurmanni Matruchot and Ramond 1905	
	Monosporium apiospermum Saccardo 1911	
IX. Due to fungi of the genera *Aspergillus* Micheli 1727, *Penicillium* Link 1809	*A. barbæ* Castellani 1907, Aspergillosis of hairy parts.	
	P. barbæ Castellani 1907, Penicilliosis of hairy parts.	
X. Due to fungi of the genera	*Aspergillus* Micheli 1725	Pinta.
	Penicillium Link 1809	
	Monilia Gmelin 1791	
	Montoyella Castellani 1907	

XI. Due to fungi of the genus *Trichosporum* Behrend 1890	*T. giganteum* Behrend, piedra.	
	Species as yet not well determined	Tropical varieties of nodular trichomycosis.
XII. Due to fungi of the genus *Pityrosporum* Sabouraud 1903	*Pityrosporum cantliei* Castellani 1907, variety of tropical seborrhœa.	

From the above table it will be seen that tropical dermatomycoses *sensû stricto*—viz., occurring only in the tropics—are comparatively few. Most of them are endemic also in temperate zones, though occurring there rarely, or at any rate less frequently, than in the tropics. We may mention as examples tinea cruris and madura foot. The same remark, however, applies to every other branch of tropical medicine.

The frequency of dermatomycoses in the tropics is probably due to the hot, damp climate being very favourable to the growth of vegetal parasites.

TINEA CRURIS (DHOBIE ITCH).

Synonyms.—Tinea tropicalis, Tinea inguinalis, Tinea axillaris, Eczema marginatum.

Definition.—The term ' tinea cruris ' indicates a group of epidermophytoses and trichophytoses which are clinically characterized by their tendency to develop on the scruto-crural and inguinal regions.

Historical and Geographical.—Tinea cruris is extremely common all over the tropics ; it is met with also in subtropical regions, and in temperate zones, being first described by Hebra in Europe under the name of eczema marginatum. In 1905, Castellani, as the result of the investigation of numerous cases, came to the conclusion that it should be separated from the ordinary forms of tinea corporis, and MacLeod suggested the name tinea cruris for the affection. For the fungus most frequently found in such cases, characterized by the yellowish cultures, Castellani used the name *Trichophyton cruris*. Pernet found and described a fungus for which Castellani suggested later the name *Trichophyton perneti*. In 1907 Sabouraud investigated in a complete manner the condition in France which he called tinea inguinalis. There can be no doubt that tinea inguinalis and dhobie itch, or tinea cruris, are the same entity, as Sabouraud and Pinoy, having compared cultures of *Epidermophyton cruris* isolated in Ceylon with those found in France, have found them identical.

Castellani's further researches have shown that other fungi besides *Ep. cruris* may give rise to tinea cruris, each species giving rise to a slightly different clinical variety of the eruption.

Ætiology.—According to Castellani's researches, at least three different species of *Epidermophytons* and one of *Trichophyton* may give rise to the eruption—*Epidermophyton cruris, Ep. perneti,*

Ep. rubrum, and *Trichophyton nodoformans*—and there are probably several other not yet described species.

The description of these fungi is given in Chapter XXVII. (see p. 788). Attempts at experimental reproduction of the disease made by Sabouraud and one of us in human beings and monkeys have failed.

Symptomatology.—The term ' dhobie itch ' is used very loosely in the tropics by the lay public to denote practically any pruriginous skin affection. The term is, however, specially used to denote a form of severe pruriginous affection which mostly affects the inner surface of the thighs, occasionally the axillæ, and, in stout women, the regions under the breasts. It is in this stricter meaning that the term is used by medical men practising in the tropics.

The clinical features of the affection correspond to Hebra's ' eczema marginatum.' In a well-marked case the perineum, scrotum, and the inner surface of the thighs present large festooned patches, with an elevated abrupt margin ; the whole of the patches are bright red, or, in a later period, the margin only is red, while the rest of the patch is of a fawnish colour, or even of normal colour. The pruritus is unbearable. Owing to scratching, a secondary pyogenic infection or an eczematous-like dermatitis may develop. The disease, if not properly treated, is extremely chronic ; the condition improves during the cold season, but gets worse again during the hot months. Patients who suffer badly from dhobie itch may get almost well in a few days, without any treatment, on going to the hills ; on returning to the plains the pruritus and all the other symptoms reappear. The affection has been known to last for many years. It is to be noted that after a time the eruption may spread to the other parts of the body—the abdomen, the trunk, legs, etc. In such situations it may develop in rings, or may form solid elevated dark red patches ; while the disease may be clinically indistinguishable from ordinary tinea circinata. In some cases, though rarely, the eruption starts first on the chest and arms, and from there spreads later to the armpits and cruro-inguinal regions.

Clinical Varieties.—The above description mostly applies to the disease as produced by *Epidermophyton cruris*, which is the commonest fungus found, and by *Ep. perneti*. In the cases due to *Ep. rubrum* the affected parts often present from the very beginning an eczematoid appearance. The edge is perhaps not so raised as in other types of tinea cruris, but very abrupt, made up of numerous rather small, close-set papules, covered at times by minute bloody crusts due to scratching. The eruption may also be present in the shape of large complete or incomplete gyrations enclosing normal skin, or solid patches may be seen. The variety due to *Ep. rubrum* has great tendency to spread to other regions of the body.

In the cases caused by *Trichophyton nodoformans* the eruption has thick elevated margins, and along the edge deep-seated nodules resembling ' blind boils ' are present, the fungus being capable of

attacking the hair follicles and having pyogenic properties. The infection may spread from the inguinal regions to other parts of the body. We have seen a case presenting a nodular eruption due to this fungus in the groins, and at the same time presenting a typical kerion barbæ due to the same organism on the right cheek.

Regions of the Body affected.—The eruption, as already stated, is generally localized to the cruro-inguinal and axillary regions, hence the name 'tinea cruris seu inguinalis'; but the same fungi may spread in many cases from those regions to any other part of the body, except the scalp. In some few cases the eruption may first appear on the arms or chest, etc., and then spread to the groins

FIG. 551.—DHOBIE ITCH OF THE CRURO-INGUINAL REGIONS: TINEA CRURIS. From the same case (due to *Epidermophyton cruris*) as the coloured plate.

and armpits, or may never affect these regions. Hence the terms 'tinea cruris' and 'tinea inguinalis' are not altogether appropriate, and the term 'tinea tropicalis,' or the native term 'dhobie itch,' might be used as general terms to cover all the localizations.

A localization of great importance noted by Sabouraud and later by Whitfield, is when the fungi invade the skin between the toes (tinea interdigitalis). In this situation the fungus—it is generally *Ep. cruris*—may remain for years, the fungus *per se* giving rise to practically no objective symptom, except perhaps a little scaliness, but generally induces very severe pruritus, especially in the hot weather. This localization of the fungus is often the starting-point

PLATE VII.

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TINEA CRURIS.

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of secondary bacterial affections causing a most distressing dermatitis, known to the planters by the name of ' mango toe,' and already described on p. 1466.

Communicability.—Tinea cruris is known in the East as dhobie itch, from the popular belief that it is contracted from linen which has been contaminated while being washed by the dhobie (native laundryman). As to how far this belief is correct we are not in a position to say. We have never succeeded in finding the fungus in clothes newly received from the dhobie, either microscopically or by inoculating small portions of the linen in sugar media. We are, however, inclined to think that the popular belief may to a cer-

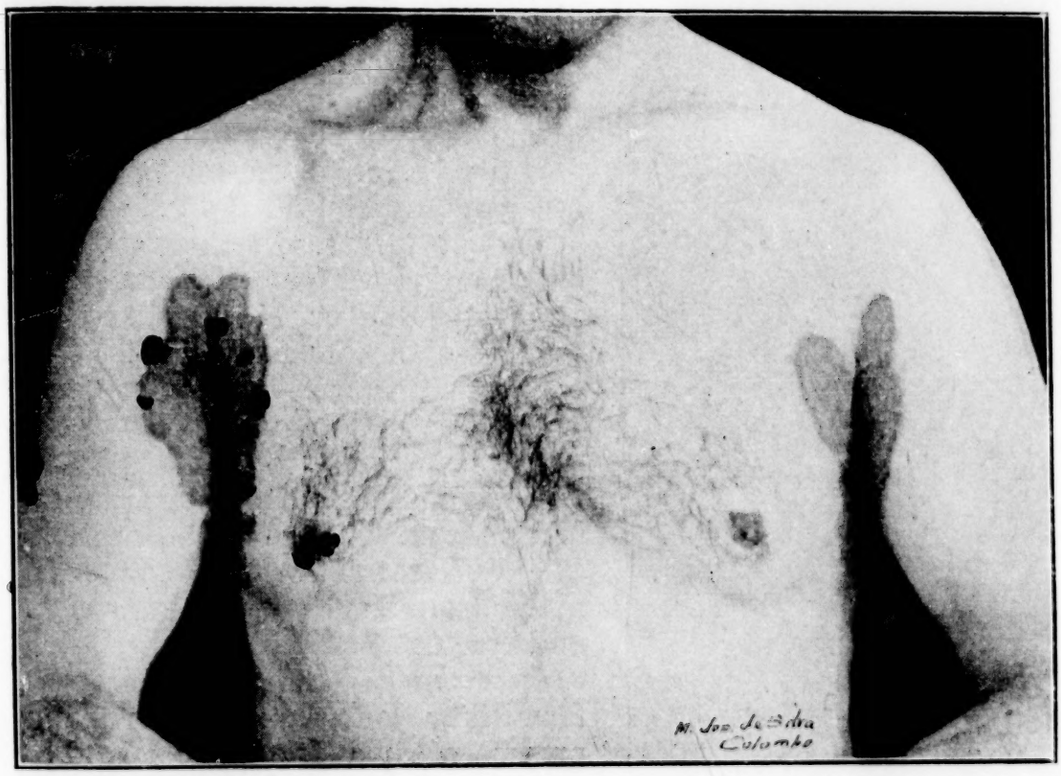

FIG. 552.—DHOBIE ITCH OF THE AXILLARY REGIONS: TINEA AXILLARIS. Case due to *Epidermophyton cruris*.

tain extent be correct. We have been told by old sufferers from dhobie itch, who used to be frequently reinfected, that on their ceasing to give their clothes to the dhobie, and having them washed in the house instead, the disease did not again affect them. In Colombo dhobies are in the habit of washing the clothes in a lake, or in small pools of water more or less stagnant. It is certain that clothes belonging to infected persons are washed together with other clothes. Dhobie itch is very contagious; true epidemics occur in schools and among soldiers in barracks.

Prognosis.—If the affection is not energetically treated, it has a tendency to become very chronic and last for years. Occasionally the eruption spreads to the whole body, forming rings or solid

patches; at other times a distressing dermatitis develops on old dhobie-itch patches, due to scratching. Tinea cruris may disappear during the cold season or when the patient goes to the hills, only to reappear as soon as the hot season commences. During the period of quiescence the skin of the affected regions often shows a brownish discoloration, furfuraceous, somewhat similar to erythrasma.

FIG. 553.—DHOBIE ITCH OF THE AXILLARY REGIONS: TINEA AXILLARIS.
Case due to *Epidermophyton cruris*.

Diagnosis.—The diagnosis is easy in recent cases, the festooned appearance of the eruption, limited by a sharp, elevated, bright red edge, being quite typical. In old cases, especially when secondary lesions due to scratching are present, the diagnosis may be very difficult, the affection being often mistaken for eczema.

In doubtful cases the microscopical examination will be of great help. It must, however, be noted that in old cases the fungus may be extremely scarce, the mycelium being practically absent, and only a few spores being found; it is well to take the scrapings for microscopical examination from the edge of the eruption. The differential diagnosis must be made from erythrasma, intertrigo, and eczema.

In *erythrasma* the patches have a fawnish or dark reddish colour, and present often a fine pityriasic desquamation; the eruption is not limited by a raised red edge; the fungus *Nocardia minutissima* is quite different from the fungi found in dhobie itch.

Intertrigo is very common in the tropics, especially in corpulent persons. The lesions are very superficial, have not a festooned contour, and the margin is not sensibly elevated; no *Epidermophyton*- or *Trichophyton*-like fungi are found. Saccharomycetic intertrigo is rare; there is no elevated margin and the fungus is found to be a Saccharomyces (*S. samboni*).

Primary eczema of the scrotum, and of the skin of the thighs in contact with it, is as frequent in the tropics as it is in temperate zones. The eczema is generally of the moist variety; the moist surface, the absence of the festooned elevated margin, distinguish

it from tinea cruris. As already stated, however, an eczematous-like dermatitis due to scratching often develops after a time on old dhobie itch lesions.

Diagnosis of the Toes' Localization.—The complaining of severe itching between the toes, even if there are no objective symptoms whatever, should in the tropics always arouse the suspicion of a possible local fungus infection, especially if the patient suffers at the time, or has been suffering from tinea cruris, and scrapings should be made and examined microscopically. It is important to make the diagnosis, as by treating the condition the development of that distressing dermatitis known as mango toe (see p. 1466) may often be prevented.

Treatment.—Our usual line of treatment is as follows :—

Mild Cases.—A resorcin salicylic ointment applied twice daily : Resorcin, ʒi. ; acid salicylic, gr. x. ; vaseline, lanoline, āā ʒiv. Tincture of iodine also is very efficacious, but induces a certain amount of smarting, and must be applied with care and in only very recent cases with no eczematoid lesions. In some cases we use Vleminckx' solution or lotio calcii sulphurati (slaked lime 4, sublimed sulphur 4, distilled water 35 ; boil together, evaporate, and filter to produce 20 of solution), pure or diluted. A sodium hyposulphite solution (sodium hyposulphite ʒii., aq. ℥i.) may also be used.

Severe Cases.—We use a chrysarobin ointment (2 to 5 per cent., a good formula being chrysarobin gr. x.-xxv., unguentum zinci ʒi.). The result is generally fairly successful. The patient should be informed that the medicine stains the linen, often irritates the skin, which may become œdematous and dusky red, and that occasionally unpleasant evidences of absorption may take place, with fever, diffuse erythema, and hæmaturia. Chrysarobin should never be used when there is some affection of the kidneys. The irritation induced by the chrysarobin ointment may be allayed by calamine lotion, lead lotion, or an ichthyol ointment 1 per cent.

Chrysarobin is obtained from araroba, which is known by the name of 'goa-powder' all over the East. The crude goa-powder, partly dissolved in vinegar, is often used, but frequently induces very severe inflammatory symptoms.

In obstinate cases we use local applications of turpentine-oil in the morning, and at night a resorcin salicylic ointment ; if the parts are much inflamed, at night simply a boric ointment. This treatment gives good results. Turpentine is generally well borne, but patients often complain of a smarting and burning sensation a quarter of an hour after the application. Exceptionally one meets with patients who cannot stand turpentine.

Cases complicated with Eczematous Dermatitis and Fissures.—In such cases, in our experience, it is better to use at first a soothing treatment by lead lotion, or a solution of resorcin (½ to 1 per cent.), or glycerin. boracis in rose-water, with the object of first healing the eczematous lesions. Later, to the rhagades which so often develop in the inguinal regions, we apply a solution of nitrate of silver (arg. nitr., gr. v.-xv. ; sp. æth. nitr., ʒi.). We touch with this solution the rhagades and the moist parts ; this application is some-

what painful, but the pain soon disappears, and the fearful itching is relieved almost immediately; moreover, the nitrate of silver destroys the fungus. At night we apply a mild ichthyol ointment (1 per cent.) or hazeline cream all over the eruption; as soon as the parts have become less moist, we begin the chrysarobin treatment. A precaution, which must always be observed during and after the treatment, to prevent reinfection is to dust all the undergarments with antiseptic powder—for instance, Manson's powder (ac. bor., zinc. ox., amyli, āā p. æq.); salicylic powder (ac. salicyl., gr. x.; talci venet., ℥i.); menthol powder (menthol, gr. v.; alcohol, q.s.; talci venet., ℥i.); dermatol powder (dermatol, gr. xx.; talci, ℥i.). It is advisable to wear small bathing-pants, which can be washed in the house.

Treatment of Generalized Dhobie Itch.—When the eruption is diffused all over the body, the simplest treatment is as a rule the application of tr. iodi or lin. iodi, treating only one portion at a time. A chrysarobin ointment (2 to 5 per cent.) may also be used.

Treatment of Dhobie Itch localized to the Toes.—During the quiescent periods, or when there is only pruritus and a little scaliness, tincture of iodine may be used, or an alcoholic solution of salicylic acid (2 per cent.). When there are acute symptoms of dermatitis, the treatment must be at first a soothing one, as described on p. 1467.

FIG. 554.—FUNGUS OF TINEA ALBA: TR. MACFADYENI CASTELLANI.

TINEA ALBA.

Remarks. — Tinea alba is in reality only a form of dhobie itch; the term is applied to various diffuse trichophytic and epidermophytic conditions which give a white powdery appearance to the skin of the natives.

Ætiology.—The commonest fungi found are *Ep. rubrum* Castellani 1909 and *T. macfadyeni* Castellani 1905, the description of which is given on pp. 787 and 789.

Symptomatology.—The arms, legs, chest, and occasionally the whole body, present a diffuse eruption of white powdery appearance, this being due to the very numerous small white pityriasic

squamæ present. The margins of the eruption, especially if the causative fungus is *Ep. rubrum*, may be distinctly raised and dotted with minute, close-set papules.

Course and Prognosis.—The course is very chronic. Apparently the fungi have a disturbing action on the production of pigment in the skin, and after some years white leucodermic patches may develop, in which no fungus is found.

FIG. 555.—TINEA ALBA.

Diagnosis.—This is based on the diffuse eruption with the abundant fine pityriasic desquamation, and with well-marked limits—and the microscopical examination. It is quite easily distinguished from tinea imbricata by the squamæ being pityriasic, very small, easily detached. In leucoderma the surface is smooth, no squamæ being present and no fungus found. As already stated, however, if the eruption is left untreated for a long time, leucodermic patches may develop.

Treatment.—The best treatment is by a chrysarobin ointment (2 to 5 per cent.), applied with the precautions already mentioned. Tincture of iodine and liniment of iodine may also be used.

TINEA ALBIGENA.

This trichophytosis was first described by Nieuwenhuis in Java. Nieuwenhuis' researches have been confirmed and enlarged by Jeanselme in Indo-China and in Siam; in the latter country the disease is known as *khi*. The disease is fairly common in the Malay Archipelago, and is occasionally met with in Ceylon.

Ætiology.—The affection is due to a *Trichophyton* first described by Nieuwenhuis—*T. albiscicans* Nieuwenhuis 1907.

The spores in fresh preparations from scrapings are almost always absent; the mycelium tubes are straight, occasionally showing a double contour; they are often dichotomous. Nieuwenhuis has grown the fungus, using Sabouraud's sugar media; the growth is very slow; the colonies are whitish, and show a powdery surface.

Symptomatology.—The eruption generally affects the palms of the hands and the soles of the feet, but may extend to the forearms and legs, and may affect the nails. It begins with the appearance of small pruriginous spots on the palms and soles; the

epidermis becomes raised, and bullæ develop, containing at first clear serum ; the bullæ break, and the skin remains dry and peels off ; the parts remain tender, and there is desquamation and pruritus. A process of diffuse keratosis develops, the palms and soles becoming double their usual thickness ; deep fissures may be formed at the natural folds. Several horny semidetached discs can often be

FIG. 556.—TINEA ALBIGENA.

seen at the dilated orifices of the sweat glands. The affection is very chronic ; it may begin in youth or in adult life. After some time a process of apigmentation of the skin sets in, white patches, leucoderma-like, developing, and extending often to the legs and arms.

Treatment.—Tincture of iodine and chrysarobin ointment (1 to 5 per cent.) answer fairly well, but the apigmented patches are not cured.

TINEA SABOURAUDI TROPICALIS.

This trichophytosis was first described by Sabouraud in patients returning from Indo-China, Japan, and Tonkin. We have seen a few cases in Ceylon.

Ætiology.—The disease is caused by the fungus *Trichophyton blanchardi* Castellani 1905 (synonym, *T. sabouraudi* Castellani 1905). The term *T. sabouraudi* cannot be applied to this *Trichophyton*, as this name has already been used for another *Trichophyton*—

PLATE VIII.

TINEA NIGRO-CIRCINATA.

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T. sabouraudi R. Blanchard 1905. This fungus cannot be grown on Sabouraud's media or any other media we have tried. Microscopically the mycelial tubes do not show a double contour, and are not very straight; they are often banana-shaped. The segments of the mycelium are all separated; the mycelial spores are roundish, and are shed without forming a filament by their union. They are of various sizes.

Symptomatology.—The eruption generally commences on the uncovered parts of the body, generally on the legs; the patients often state that they think the disease is due to prolonged immersion in stagnant water. The affection begins with erythematous patches, the surfaces of which are covered with minute pityriasic squamæ. After reaching the diameter of about 1 or 1½ inches, the patches become circinate. The circination, however, is incomplete; it is only segmentary. In dependent positions large polycyclic patches may be seen, but only one-half or one-third of the circles are clearly seen, the rest being badly defined. The base of the patches at this stage is of a very dark bistre-brown colour. The border shows polymorphic lesions, fine pityriasic squamæ, minute vesicles and papules. The pruritus is very marked, and excoriations, due to scratching, are constantly present. In chronic cases a thickening of the skin, with lichenification, takes place, specially at the circinate borders.

Treatment.—The disease is difficult of cure in the tropics, though it may disappear spontaneously on the patient proceeding to Europe. Chrysarobin ointment (1 to 4 per cent.) is the best treatment.

TINEA NIGRO-CIRCINATA.

This trichophytosis has been observed by one of us among Sinhalese natives.

Ætiology.—The eruption is due to a *Trichophyton—T. ceylonense* Castellani 1908. The spores are very few in number, roundish, rather large (4 μ), and showing a double contour. The mycelial tubes are about 3½ μ in breadth, generally straight. The fungus does not grow on any of the ordinary or Sabouraud's media.

Symptomatology.—The eruption is found most frequently on the neck and scrotum, and consists of a few rings with thick, elevated margins, the encircled skin being black—much darker than the healthy skin—but not thickened nor presenting papules, vesicles, or pustules. The edge is thick, elevated, of a dark colour, with the upper portion pinkish or occasionally covered by a dark crust. The eruption often heals spontaneously, leaving dark roundish patches at the previous seat of the lesions.

Prognosis.—The eruption may disappear spontaneously, and the treatment is easy.

Diagnosis.—The only dermatomycosis to which it has a slight resemblance is *Tinea sabouraudi*. The latter, however, is very

chronic, and invades large portions of the body; the rings are segmentary, not complete, and the edge is not so thick and elevated.

The condition may have also to be distinguished from a circinate framboeside or ringworm yaws, in which no fungus is found, while *Treponema pertenue* is present.

Treatment.—Tincture of iodine, freely applied, answers well.

TINEA CAPITIS TROPICALIS.

Geographical Distribution.—Tinea capitis is found in every part of the tropics, but its incidence varies from country to country, and is far less common than epidermophytoses and trichophytoses of the body.

FIG. 557.—TINEA CAPITIS DUE TO TR. VIOLACEUM V. DECALVANS.

In our experience tinea capitis is less common in India, Ceylon, and tropical Africa than in Europe and America. On the other hand, it is extremely common in American negroes.

Ætiology.—The fungi found are generally of the genus *Trichophyton*, but many of them have not yet been completely studied. In Ceylon the commonest fungus is *T. violaceum* Sabouraud *var. decalvans* Castellani; in tropical Africa, *T. soudanense* Joyeux is common; in South America *T. polygonum* Uriburu, *T. exsiccatum* Uriburu. We have never come across cases due to *Microsporon audouini;* but Jeanselme and others have described a few such cases. Horta has described a rare species of *Microsporon—M. flavum*—in Brazil.

Symptomatology.—It may be said in a general way that the principal clinical signs are the same in the tropical types of the affection as in the temperate zones, though the medical man who has studied the subject thoroughly will soon be able to detect small clinical differences, and will soon realize that as a general rule each fungus gives rise to a slightly different type of the disease.

The principal signs are scaly patches on the scalp and the stumps in which the fungi will be found by examining them microscopically in liq. potassæ. A few remarks may be made on the commonest type of tinea capitis observed by us in Ceylon. It generally attacks children, especially of the moormen community.

The scalp presents one or several white patches covered with an enormous number of heaped-up white pityriasic scales. The scales and the broken hairs, examined microscopically, show presence of an endoectothrix fungus, which, when cultivated, shows practically every character of *T. violaceum* Bodin. A very serious symptom is that the patches as a rule remain permanently bald.

Prognosis.—This is rather bad in the common variety found in Ceylon, due to *T. violaceum var. decalvans*, as the patches in most cases remain permanently bald, though fortunately they are, as a rule, of small dimensions. The treatment of every type of tinea capitis is long unless X rays are used.

Treatment.—The Röntgen rays treatment, using Sabouraud's method, is by far the best and quickest. Details on the technique will be found in any up-to-date book on dermatology. In many tropical places this treatment is out of the question, and epilation and application of turpentine oil, tincture of iodine, or—with care—a chrysarobin ointment (2 to 5 per cent.) must be resorted to.

Garrett recommends the application of liquor ferri perchloridi fort. (B.P.) after thorough cleaning of the patches with benzene.

TINEA BARBÆ TROPICALIS.

The same remarks can be made on this subject as on tinea capitis. Cases are found in the tropics, though apparently less frequently than in temperate zones, and the fungi have so far been very little investigated. In Northern Africa a fungus commonly found is *T. violaceum* Bodin ; in Ceylon *T. nodoformans* Castellani is often found.

Symptomatology.—The dry variety, with scaly often gyrated lesions, and the pustular variety, with purulent folliculitis, can be distinguished.

We have seen a typical case of kerion barbæ due to *T. nodoformans* in a person who was suffering from tinea cruris due to the same fungus.

Diagnosis.—The diagnosis, in the pustular type, is based on the spreading folliculitis with brawny swelling and the microscopical examination of the hair ; in the scaly type, on the frequent gyrate type of the eruption and the microscopical examination of the scales and hair.

Prognosis.—The disease takes a long time to get well, even under appropriate treatment.

Treatment.—This consists in epilation of the affected region, each day clearing a square inch or so, followed by the application of some antiseptic ointment such as Crocker's ointment of sulphur, ℥ss.-℥i. ; ac. carbol., ℥ss. ; lanolin c̄ oleo, ℨi. ; or oleate of copper, ℥ss. to ℨi.

Tinea ciliorum.

We have seen a case of this affection in a man suffering from generalized dhobie itch, due to *T. nodoformans*. The lid was swollen and red, many cilia were broken, and there was purulent inflammation of the hair follicles.

TINEA UNGUIUM TROPICALIS.

Synonym.—Onychomycosis tropicalis.

Cases of tinea unguium, or onychomycosis, occur in the tropics, and are generally due to the same fungi producing dhobie itch, both *Epidermophytons* and *Trichophytons*. The nails of the fingers as well as of the toes may be affected. Tinea unguium may be caused also by fungi of the genus *Endodermophyton*, the nails being often affected in tinea imbricata.

Symptomatology.—The affected nails have often a peculiar yellowish opaque or blackish discoloration, and a rough surface; they become brittle, and splitting and chipping of the free border takes place.

The diagnosis is principally based on the microscopical examination of scrapings. A soaking in liq. potassæ (40 per cent.) for twenty-four hours is often necessary to disintegrate the nail substance and to find the fungi.

Treatment.—This is most difficult. The affected nails must be softened by rubbing in liquor potassæ, and then wet dressings of hyposulphite of soda (25 per cent.), or a solution of potassium iodide grms. x., iodine grm. i., water 1,000 c.c., must be regularly applied. In the onychomycosis found in cases suffering, or having suffered, from tinea imbricata, the daily application of resorcin in tincture of benzoin (℥i. to ℥i.) is useful.

TINEA IMBRICATA (TOKELAU).

Synonyms.—Tokelau (Samoa); Gogo (Marshall Islands); Pita (Bowditch Islands); Cascado (Moluc Island); Dermatomycosis Chronica Figurata Exfoliativa (Thomson); Herpes Farinosus (Ritter); Herpes Desquamans (Turner); Herpes de Manson (Roux).

Historical and Geographical Distribution.—The first reference to this disease is found in Albert's atlas, 1832. Fox, in 1844, described it under the name of 'gune.' He observed it in the Gilbert Islands, and 'gune' was the term used by the natives to indicate it (gune=skin). It is to Manson that we owe the first scientific description of the disease; he introduced the term 'tinea imbricata,' under which the disease is now generally known. Manson's researches have remained classical. Further researches were made by Turner, Köniğer, MacGregor, and more recently by Tribondeau, Nieuwenhuis, and many others. The disease has long been known in the New Hebrides, Papua, the Gilbert Islands, and in the Malay Peninsula. It is at the present time extremely common in Fiji, where it was imported about the middle of last century, and many other of the Pacific Islands; it is found in the Philippine Islands, in Southern China, Tonkin, and Java. Lately the distribution of the disease has much extended; many cases have been seen by us in Ceylon and Southern India, in which countries the disease was

believed to be non-existent. Cases have also been reported from Brazil and other parts of tropical America.

Ætiology.—The ætiology of this dermatomycosis has been the subject of numerous controversies. Manson first, in 1872, described a trichophyton-like organism in the squamæ; with the laboratory technique of that time attempts at cultivation did not succeed. Blanchard considered it non-cultivable and called it

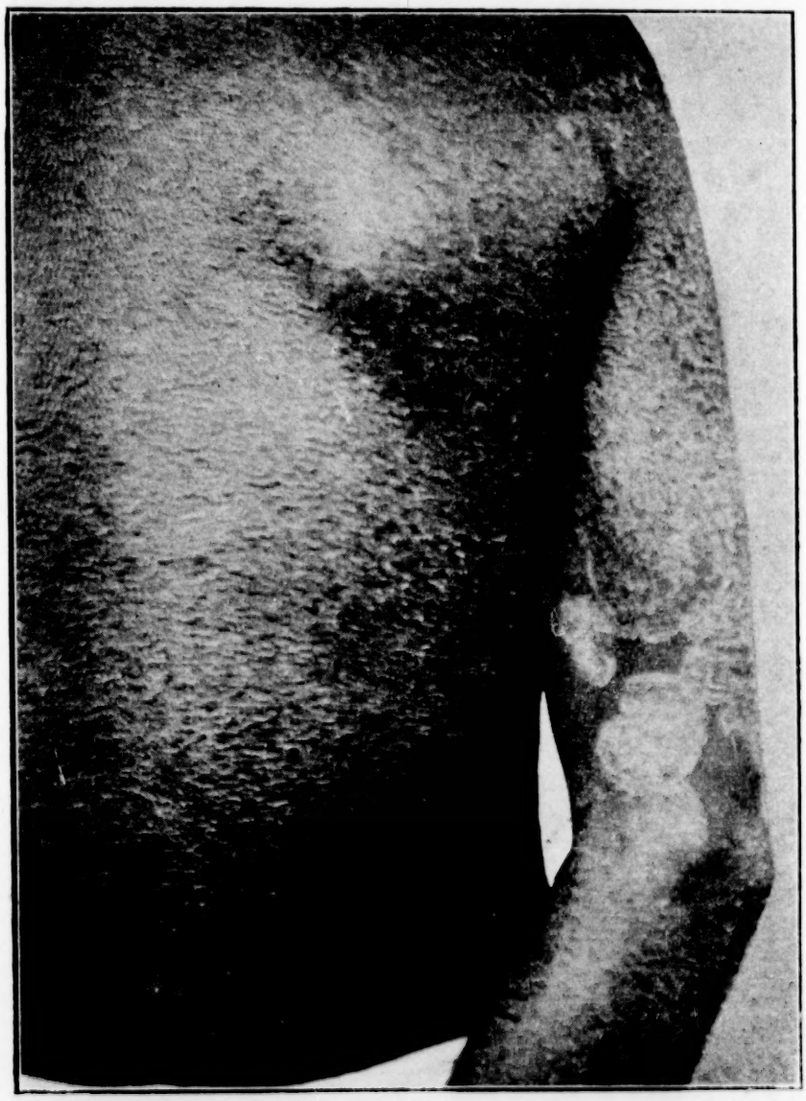


FIG. 558.—TINEA IMBRICATA.

'*Trichophyton concentricum*'; on the other hand, Nieuwenhuis stated that it was quite easily cultivated and was characterized by the colonies being crateriform. His results were not confirmed. In recent years the general opinion has been that aspergillus-like fungi were the real cause of the disease. Tribondeau described fructifications somewhat similar to those of an aspergillus, and created for the fungus the genus *Lepidophyton* (λέπις = scale; φυτόν = plant). Wehmer has described it as a true aspergillus—*Aspergillus*

FIG. 559.—TINEA IMBRICATA.

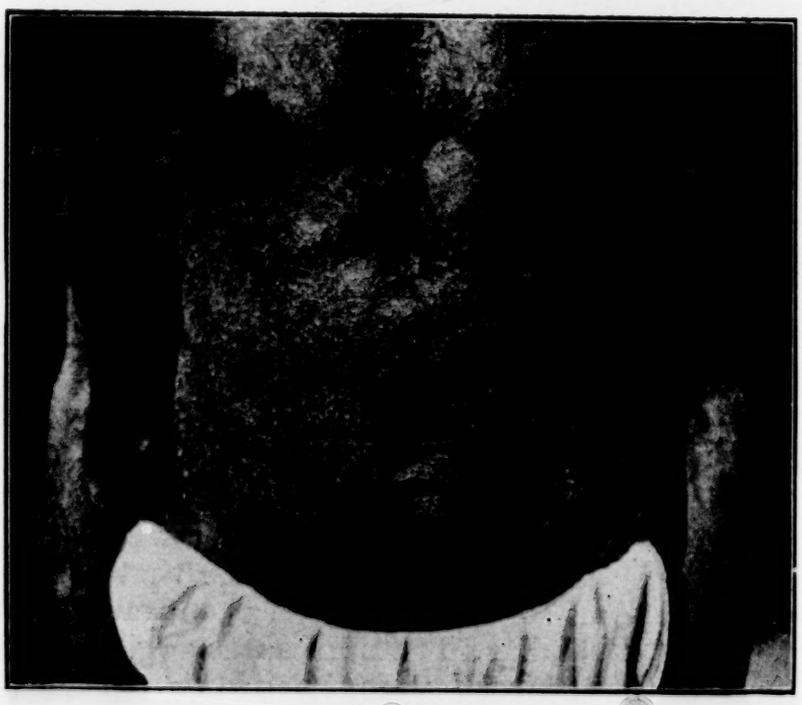


FIG. 560.—TINEA IMBRICATA.

tokelau. The investigations carried out by Castellani have demonstrated that the aspergillus and aspergillus-like fungi have nothing to do with the disease. When they are present in the squamæ, they are merely saprophytes or contaminations. By using a special technique he has succeeded in growing the true fungi causing the disease, which must be placed in the genus *Endodermophyton*. He has grown two species, and has suggested that the term 'concentricum' introduced by Blanchard should be retained for one species. For the other species he has suggested the term 'indicum.' It is probable that further investigation will reveal the existence of some more species.

FIG. 561.—FUNGUS IN THE SCALES.
(From a stained preparation.)

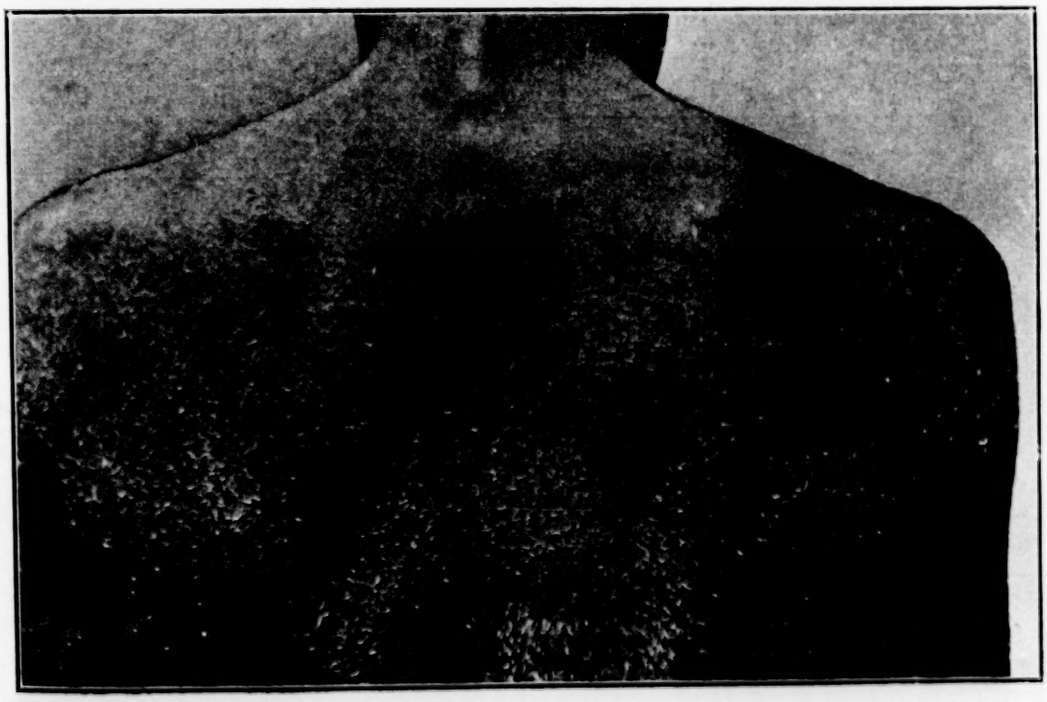


FIG. 562.—TINEA IMBRICATA.

Predisposing Causes.—It is doubtful whether there is any racial disposition. In Fiji, however, while extremely common in the Fijians, it is comparatively rare in the immigrant Indian coolies.

The Tongans also are said to contract the disease rarely, and this relative immunity, according to them, is due to the habit they

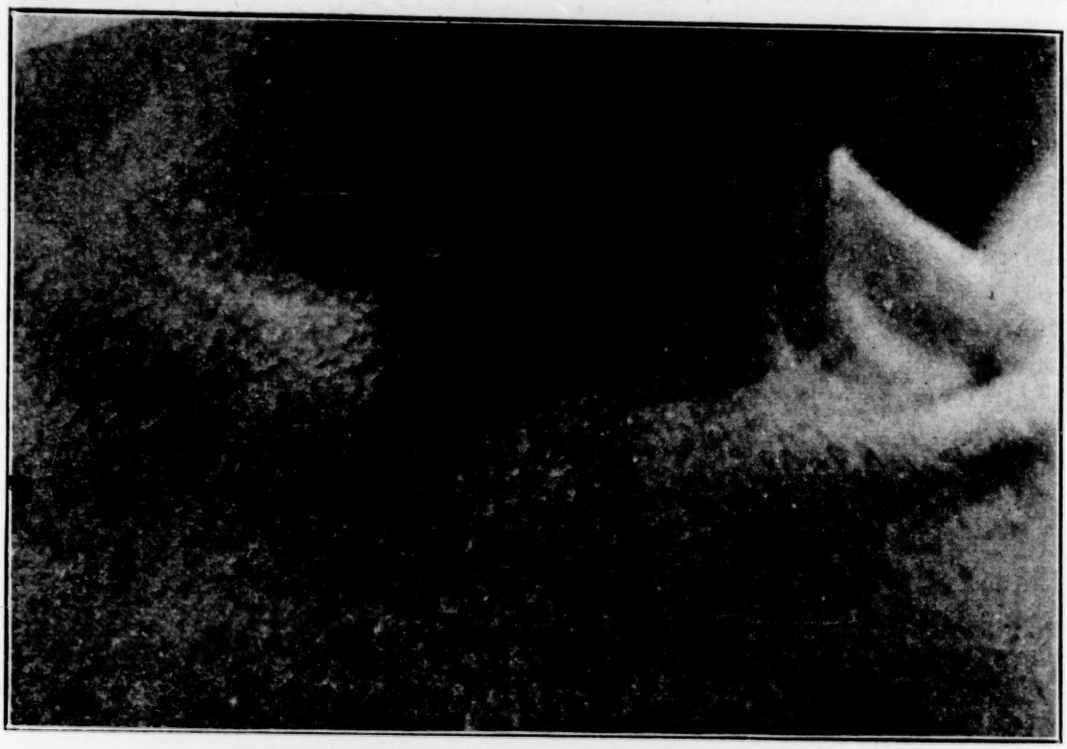


FIG. 563.—TINEA IMBRICATA.

FIG. 564.—TINEA IMBRICATA.

have of regularly anointing their bodies, which the Fijians do not. A hot, moist climate seems to be the most suitable for the development of the fungus and the spreading of the disease.

Symptomatology.—In a well-marked case the skin of practically the whole body is covered with round patches, each of which presents several concentric scaly rings. The scales are flaky, resembling tissue-paper, dry, of a dirty greyish colour, and slightly curled. If the scales are removed, rings of concentric, circular, dark lines remain visible. The number of rings forming the patch varies. Tribondeau states that they are not more than four; we have, however, frequently counted as many as eight and ten in the same patch. The eruption may spread to any part of the body, except, in our experience, the scalp. Though several authors state that the eruption never affects the face and axilla, and rarely the palms and soles, we have often observed it in such situations. It is also stated that the nails are not affected, though Manson, who first

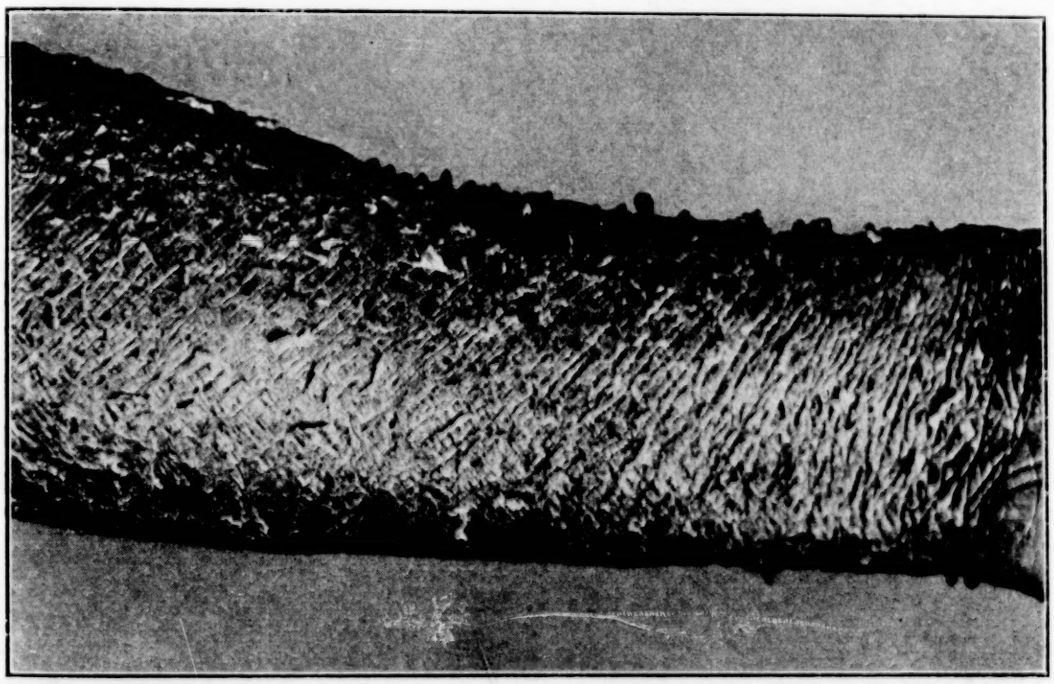


FIG. 565.—TINEA IMBRICATA OF THE FOREARM (OLD CASE.)

completely described the disease, said that the nails being affected was of frequent occurrence. Our experience tallies with that of Manson. The nails, when affected, are much thickened, have a rough surface and deep cracks. Scrapings examined in liquor potassæ show the fungus. The fungus never invades the hair follicles. The general health is not affected, but the patients complain of the disfigurement and of the unbearable pruritus. The pruritus greatly increases, apparently, if the patient is given certain diets—for instance, dry-fish diet. In the hot season the pruritus is much more marked. The disease is very chronic, and very difficult to cure.

In nearly all our cases the blood showed a certain degree of eosinophilia, the number of eosinophile leucocytes varying between 6 and 16 per cent. In some cases this eosinophilia was probably

due to the presence of intestinal worms ; the eosinophilia, however, was observed in some cases in which the microscopical examination of the fæces did not show any ova of worms. In very old cases the eosinophilia is more marked than in recent ones ; in old cases signs of anæmia may be present.

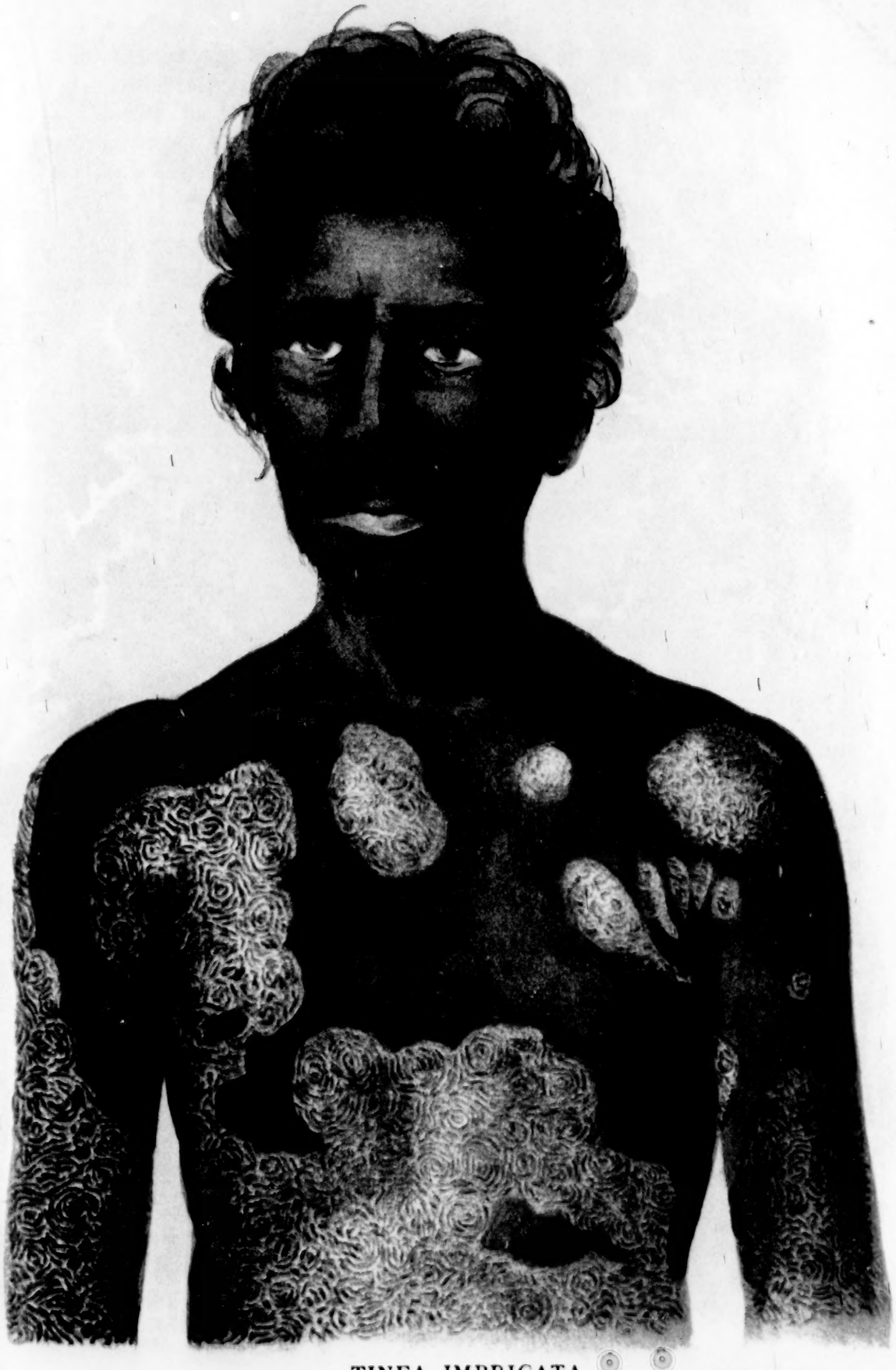
Clinical Varieties.—The eruption may after a time, or from the very beginning, have a diffuse appearance instead of showing concentric rings. The scales, however, are typical and identical to those found in the concentric type—viz., they are large, tissue paper-like, partially covering each other like the tiles of a roof, and most of them firmly adherent by their bases.

FIG. 566.—TINEA IMBRICATA.

The same fungus — viz., either *Endodermophyton concentricum* or *E. indicum* —may give rise at times to the concentric type, at other times to the diffuse type. In some cases the lesions caused by *E. indicum* seem to be slightly different from those given by *E. concentricum*, the lesions being, perhaps, a little more superficial and the scales not situated so close together ; but further investigation is necessary on the point. We believe that further researches will show that there are several other species of *Endodermophytons*, each of which will probably give rise to a slightly different clinical variety.

Experimental Reproduction of the Disease.—The malady can be easily reproduced in human beings either by inoculating squamæ from a patient, as done by Manson, or by inoculating pure cultures of the fungi, as done by Castellani. With the first procedure the period of incubation is shorter, varying between seven and ten days ; after this time a slightly elevated brown patch is seen at the place of inoculation, in the centre of which the epidermis gives way and a ring of scales is formed ; this ring expands peripherally, the scales being free towards the centre, and attached to the sound epidermis

PLATE IX.



TINEA IMBRICATA.

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at the periphery. While the ring expands towards the periphery, another dark patch appears in the centre, which later breaks, and another ring is formed inside the first, and so on.

Experimental Reproduction by Inoculating Pure Cultures.—The disease is easily reproduced in human beings by inoculating pure cultures of the fungi, as done by one of us. The incubation period is somewhat longer (twelve to twenty days), but the eruption develops typically, as may be seen in Figs. 567 and 568. It is interesting to note that if old cultures are used instead of young

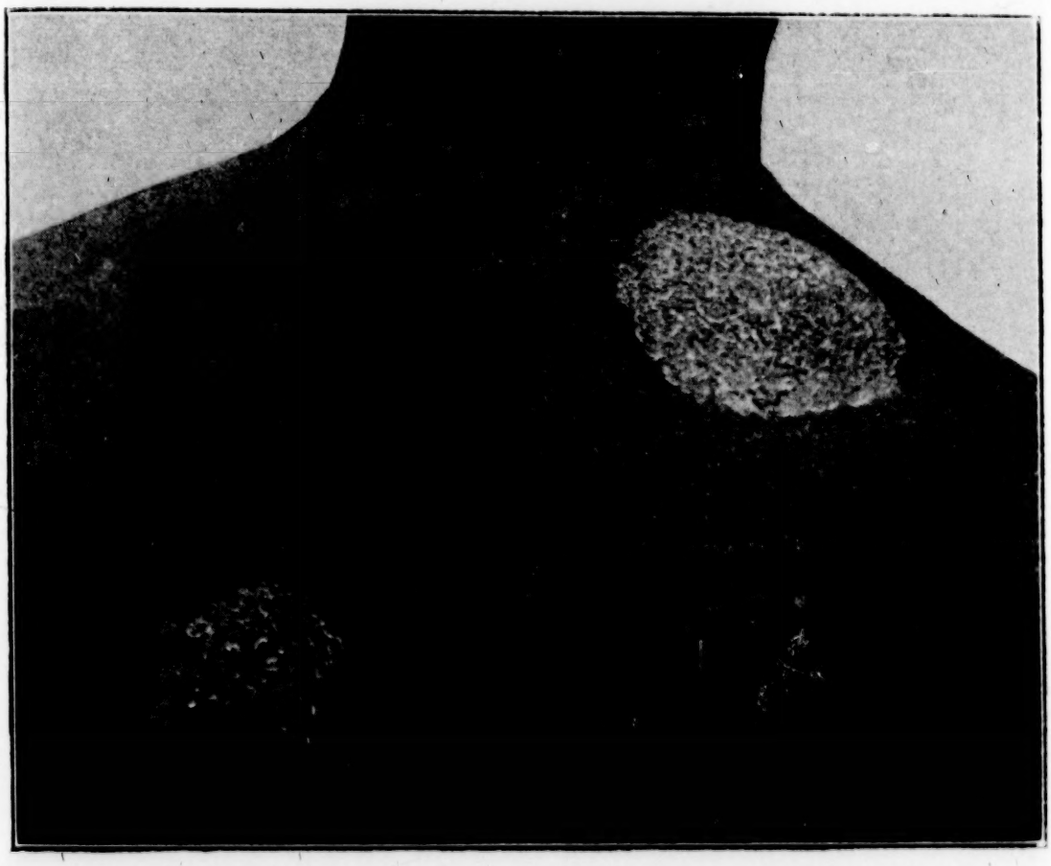

FIG. 567.—EXPERIMENTAL TINEA IMBRICATA OBTAINED BY INOCULATING CULTURES OF ENDODERMOPHYTON CONCENTRICUM.

ones, the inoculation may fail completely, or only an evanescent, superficial, papuloid, trichophytic-like patch may be induced.

Prognosis.—The general health is not affected. The patient complains of the disfigurement, which is very great, and of the pruritus, which in the hot season may be unbearable. Europeans complain also of pain, especially if the fungus attacks the hands. The disease has no tendency to recover spontaneously; its treatment is difficult, and cases apparently cured often show a return of the eruption after a few weeks or months.

Diagnosis.—The disease, once seen, cannot be confused with any other dermatomycosis; its development in concentric rings, fringed with large tissue-paper-like scales, is absolutely character-

istic. Even when the concentric rings are not present and the eruption is diffuse, the diagnosis is easy, being based on the characteristic large scales, partially covering each other like tiles on a roof.

Treatment.—Every medical man practising in the tropics well knows how difficult is the treatment of tinea imbricata. It is easy to obtain a temporary improvement, and even a disappearance of the eruption; but as soon as the treatment is discontinued, the eruption, as a rule, starts afresh.

FIG. 568.—EXPERIMENTAL TINEA IMBRICATA OBTAINED BY INOCULATING CULTURES OF ENDODERMOPHYTON INDICUM.

Compare with Fig. 567. Note the different clinical appearance from experimental tinea imbricata induced by *Endodermophyton concentricum*.

Strong iodine liniment, as recommended by Manson, or resorcin dissolved in tincture of benzoin (resorcin, ʒii.; tr. benz. co., ʒi.), as recommended by Castellani, or chrysarobin ointment (5 per cent.) give, on the whole, the best results.

In the Colombo Clinic of Tropical Medicine one of us has made various experiments to test the efficacy of the various medicaments by applying simultaneously different liniments, ointments, etc., to symmetrical parts of the body, and comparing the result. According to his results:—

Sulphur has practically no effect whatever on the fungus.

Turpentine generally induces a slight improvement, some scales disappearing, and the skin becoming smoother; the improvement, however, is not permanent, and as soon as the turpentine application is discontinued the typical scales reappear.

Calomel and other ointments of mercurial preparations do not induce any improvement in the eruption.

Thymol and *Naphthol* ointments may cause a slight improvement.

Carbolic Acid and *Epicarin* ointments have no effect whatever.

Cyllin ointment (20 to 50 per cent.) may induce a temporary improvement.

Formalin is very effective for localized patches. The usual 40 per cent. solution is applied with care, treating each time a small portion of the erup-

tion. Formalin often causes severe pain and a certain degree of inflammation, which is best relieved by applications of iced water. Soon after the application of formalin the patches become dark brownish, which colour lasts for a few days, when they clear. Care must be taken not to apply the formalin to too large portions of the skin, and not to repeat the application too often; otherwise a peculiar form of apigmentation, similar to leucodermic patches, may appear later on, to which disfigurement coloured patients strongly object.

Chrysarobin.—The repeated application of chrysarobin ointment (30 grains to 1 ounce of vaseline) may induce a strikingly rapid improvement in cases which are not of long standing. The eruption, however, recommences a few days or weeks after its apparent disappearance. Chrysarobin is a very toxic medicament; the patient must be watched and the urine regularly examined. In one of our cases symptoms of absorption appeared after a single application.

Salicylic Acid and *Methyl Salicylate* have very little, if any, action on the fungus.

Tinctura Iodi and *Linimentum Iodi.*—Tinctura iodi, freely applied, induces a very marked improvement, which, however, is not permanent. Strong iodine liniment, as recommended by Manson, is most effective; it cannot be used freely, however, on patients with a delicate skin, such as women and children.

Resorcin and Tincture of Benzoin.—Resorcin, alone or mixed with salicylic acid in alcoholic solution and in ointments, has very little efficacy. If, however, resorcin be dissolved in tinctura benzoini composita (60 to 120 grains of resorcin to 1 ounce of the tincture of benzoin), very good results are obtained; it is now the routine treatment for tinea imbricata in the Colombo Clinic. It is to be noted that tincture of benzoin without resorcin has very little action on the eruption. The resorcin, dissolved in tincture of benzoin, should be applied freely once or twice daily on the affected regions. If the whole body be affected, one day one half is painted, and the other day the other half, alternately. The treatment must be continued for several weeks. Once or twice a week the patient is given a very hot bath, and scrubbed all over with sand-soap. Symptoms of absorption are rare; it is always prudent, however, to proceed at first with care, as it is well known that individuals may be met with, though rarely, showing idiosyncrasy for resorcin.

Prophylaxis.—Isolation, as recommended by some authorities, is hardly practicable in the regions where the dermatomycosis is, or has become, endemic, as the number of people suffering from the disease is usually very great. In tropical countries, however, where the disease has not yet appeared, the medical officers should be on the lookout, and if a case is reported, the patient should be kept isolated and thoroughly treated before allowing him to mix with the other patients or with the general population. We have seen a small epidemic of tinea imbricata in a hospital where a patient suffering from the complaint was allowed to mix with the other inmates.

TINEA INTERSECTA.

This dermatomycosis and its fungus were first described by Castellani in 1907. It occurs in Ceylon and Southern India.

Ætiology.—If a portion of one of the brown patches or a scale be removed and treated with liquor potassæ, the fungus is easily detected. The fungus (*Endodermophyton castellanii* Perry 1907) grows between the superficial and the deep strata of the epidermis.

It is present on the inner surface of the scales, but not on the external surface. A very remarkable fact is the extreme rarity of free spores ; in fact, in several cases one does not succeed in finding spores. The mycelium is fairly abundant, though far from being so abundant as in tinea imbricata. It is composed of long, straight articulated threads, which are sometimes dichotomous, the breadth being between 3 and $3\frac{1}{2}$ μ. Each segment presents in fresh preparation two refractile bodies, one at each extremity. No aspergillar fructifications nor clusters of spores are seen. Attempts at growing the fungus have succeeded only in one case, the growth being very similar to that of *E. indicum*.

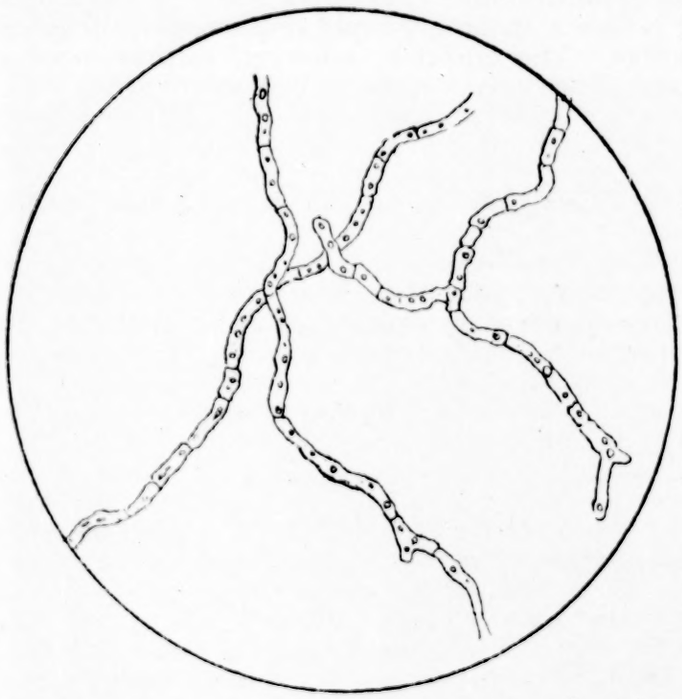

FIG. 569.—FUNGUS OF TINEA INTERSECTA.

Symptomatology. — The eruption begins with small oval or roundish, very slightly elevated itching patches, generally situated on the arms, legs, chest, and back. The margins of these dark spots are at first slightly elevated, and dotted often with minute dark papules. The patches are dark brown in colour, much darker than the surrounding skin, and present a smooth, tense surface at first ; they increase in size slowly, and some coalesce. After a certain time the surface of the patches is no longer tense ; it becomes somewhat shrivelled and dry ; superficial cracks appear in it, so that white lines are visible intersecting the brown surface. Later the cracks become deeper, the epidermis splits, and several flaky, curled-up scales, whitish inside and dark on the outer surface, are seen ; the scales are often removed by friction, and whitish roundish patches only remain. The eruption never develops in concentric rings like tinea imbricata ; the patches remain isolated or fuse together, forming irregular larger patches. Some patches may disappear spontaneously after a time. The general health of the patient does not seem to be affected. In some patients there is a slight degree of eosinophilia.

Diagnosis.—When the eruption is in the very first stage it might be mistaken for a form of pityriasis versicolor. In pityriasis versicolor, however, the epidermis does not split ; moreover, in tinea intersecta the fungus is not found on the surface : it grows between the superficial and deep layers of the epidermis. Tinea imbricata

PLATE X.

TINEA INTERSECTA (FOREARM).

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begins in a manner somewhat similar to tinea intersecta, dark brownish patches being present, and the fungus in both eurptions growing between the superficial and deep layers of the epidermis. In contrast to tinea imbricata, however, the eruption of tinea intersecta never develops in concentric rings; is far less severe, as patches may heal spontaneously; and is cured without much difficulty.

Treatment.—Tincture of iodine and the usual antiseptic ointments, such as chrysarobin (2 to 5 per cent.), answer well.

TINEA FLAVA (*vide* Plate XI.).

Synonyms.—Tropical Pityriasis Versicolor of the old authors, Microsporosis Flava (Castellani), Achromie Parasitaire (Jeanselme), Pityriasis Versicolor Flava (Castellani), Achromia Squamosa (Crocker).

This dermatomycosis is extremely common in all tropical countries, and especially so in Southern India, Ceylon, Malaya, Java, Indo-China, and China. By many authors it has been, and is still, confused with the ordinary pityriasis versicolor of temperate zones; the investigations of Jeanselme and Castellani, however, have clearly proved that it is a different affection.

FIG. 570.—FUNGUS OF TINEA FLAVA.

(From a specimen stained by the Morris-Walker method.)

Ætiology. — The affection is due to *Malassezia tropica* Castellani 1905. The mycelial threads are generally thick, with numerous swellings, constrictions, and other irregularities in their shape. The spores are roundish or oval (3·50 to 4·50 μ), and have a double contour. In recent cases the fungus is abundant, with plenty of mycelium and spores which often run into clusters. In old chronic patches the fungus becomes very scanty; the spores are not numerous, and generally do not collect in clusters; the mycelium is very scanty, and is even more irregular in shape than it is in recent patches (degeneration forms of the fungus).

Symptomatology.—The affected parts are yellowish, of much lighter colour than the surrounding healthy skin ; the yellow colour may be of various tinges, from dark, deep orange-yellow in some cases to very light canary-yellow in others. The patches are of various sizes, generally roundish, smooth, sharply defined, with margins not elevated, or only slightly so. Sometimes the patches are irregularly festooned,and may encircle an area of healthy skin. Occasionally the encircled healthy skin appears to be intersected

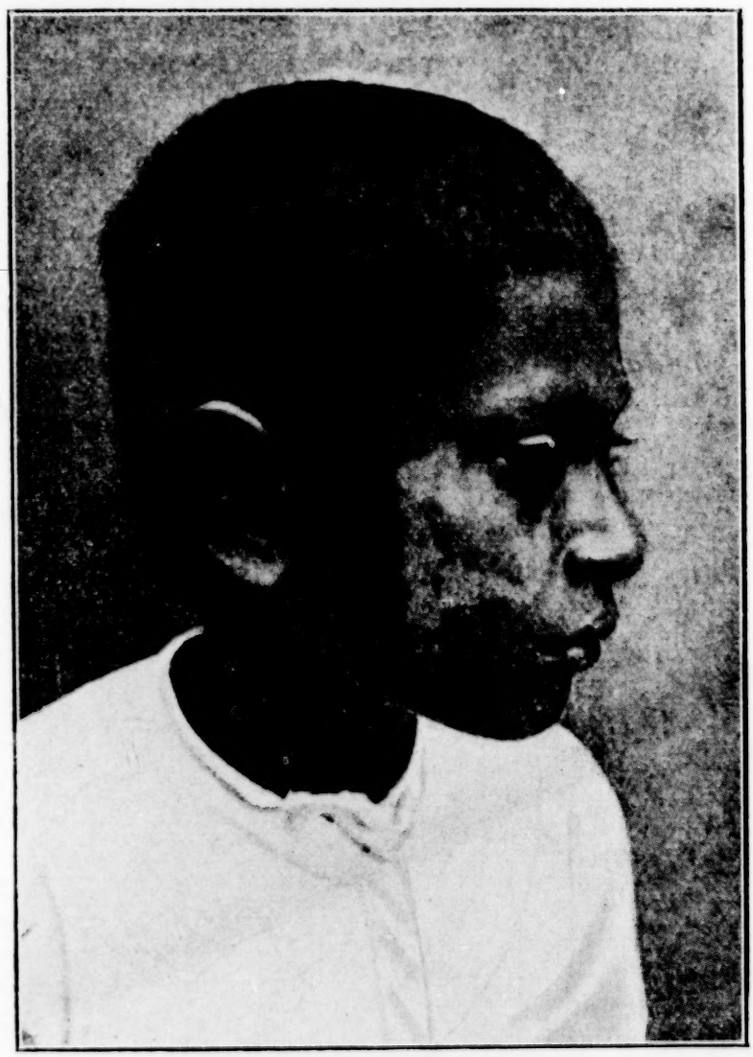

FIG. 571.—TINEA FLAVA ON THE FACE OF A SINHALESE.

by many yellowish, ribbon-like lines originating from the surrounding yellow patch. The regions more frequently affected are, in order of frequency, the face, neck, chest, and abdomen. Large portions of the body may be involved. There is, as a rule, no pruritus. The patches are not desquamating, or only very slightly so. The course of tinea flava is very chronic. In the natives of the lower classes it appears in childhood in the shape of tiny spots on the face and chest, spreading slowly during years ; they may

coalesce, covering practically the whole of the face and chest. One is occasionally surprised to see a native whose face and chest

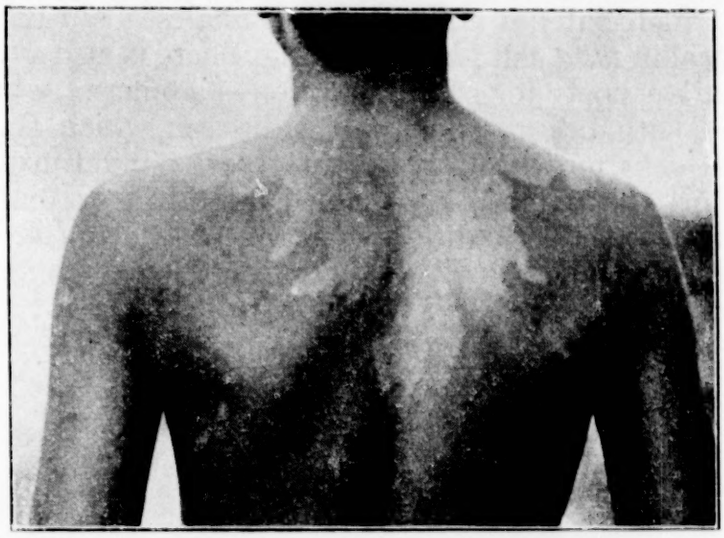

FIG. 572.—TINEA FLAVA ON THE BACK.

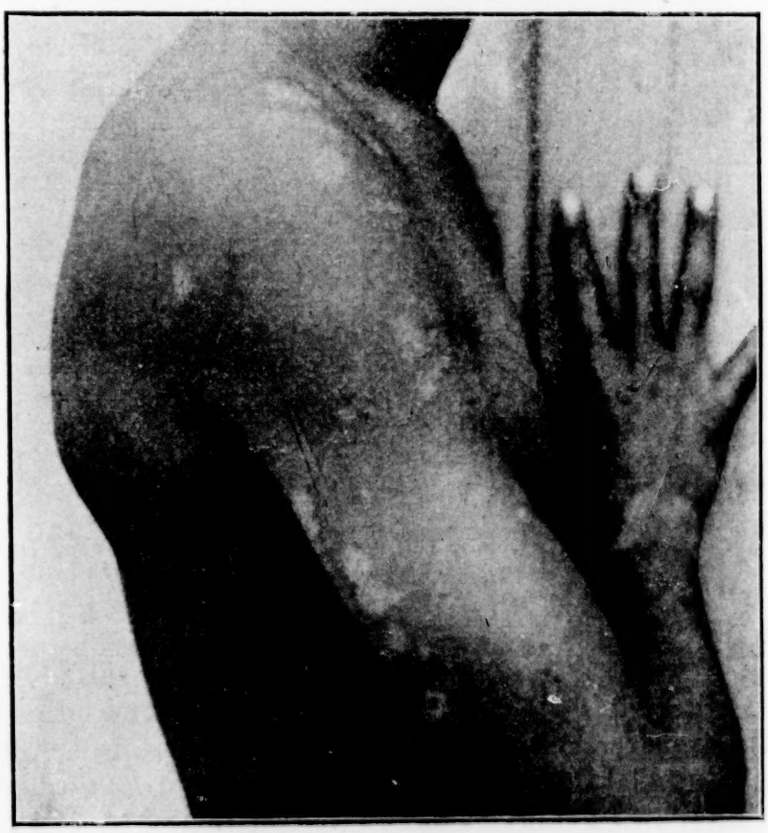

FIG. 573.—TINEA FLAVA OF THE ARM.

are quite light in colour; on closer examination, it may be found that this lighter appearance is due to a diffuse, very light-coloured form of tinea flava, covering the whole of the face, neck, and chest.

In Ceylonese native women, when the patches of tinea flava are small, light, and situated on the face, they are considered to be beauty-spots, and are highly appreciated by the ladies and their admirers. Such patches are called in Sinhalese ' alu-hama,' which means ashy skin (*alu*, ash ; *hama*, skin). There is also another word used by native poets for such condition—' gomera,' which means skin dotted with beauty-spots. The disease, which is extremely common, attacks mostly natives, but occasionally Europeans also. In Europeans the patches are yellowish-reddish or pinkish (tinea rosea), and may be due to different strains of *M. tropica*.

Prognosis.—The disease is very chronic and has no tendency whatever to spontaneous cure, but the general health is not affected.

FIG. 574.—TINEA FLAVA : VARIETY GUTTATA.

Diagnosis.—*Pityriasis versicolor* of temperate zones is not of so light a tinge as tinea flava, never attacks the face, and is curable with the greatest facility ; while tinea flava affects the face more frequently than any other part of the body, and is curable only with difficulty.

Tinea Alba.—Occasionally there may be some difficulty in distinguishing tinea flava of a light variety from tinea alba. In contrast to tinea flava, the patches of tinea alba are not smooth, and the fungi belong to the genera *Trichophyton* and *Epidermophyton*.

Tinea Flava and *Pinta* are easily distinguished by the characters of their respective fungi, the fungus found in pinta never having the characters of a *Malassezia*.

Leucoderma patches have a characteristic dead-white colour, are often surrounded by a hyperpigmented border, and no fungus is found.

In *Circumscribed Scleroderma* (Morphœa) the patches may present a peculiar yellowish tinge, which in coloured patients may resemble tinea flava. In tinea flava, however, there is no change in the texture of the skin, which is still pliable, and does not exhibit the peculiar parchment-like feeling of scleroderma. The microscopical examination will clear the diagnosis in any doubtful case.

In Europeans, tinea flava, taking often a reddish colour (hence the term 'tinea rosea'), especially if the patient has been exerting himself, and is perspiring, might, on superficial examination, be mis-

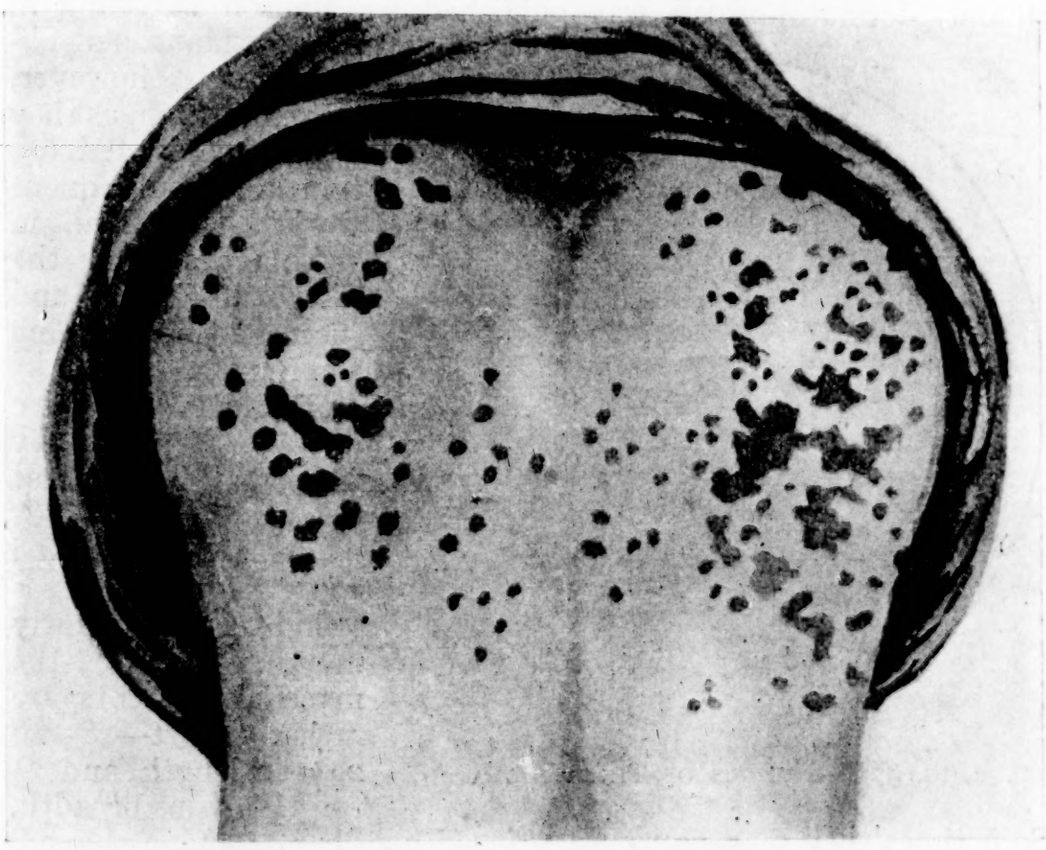

FIG. 575.—TINEA FLAVA ON THE BACK OF A EUROPEAN.

taken for a form of *Seborrhœa corporis*. The microscopical examination will clear the diagnosis, no *Malassezia* fungus being found in seborrhœa corporis.

Treatment.—Tinea flava shows no tendency to spontaneous cure, unless the patient moves to a cold climate. Even then, very often the cure is only apparent, as the condition reappears during the hot weather. The treatment is difficult. Turpentine applied daily, followed by a naphthol or epicarin ointment (2 to 5 per cent.), or a salicylic-resorcin ointment (resorcin ʒi., acidi salicyli gr. x., vaselini ʒi.), is often successful, but the treatment must be continued for months. On covered parts of the body tincture of iodine may be used, or a chrysarobin ointment (2 per cent.).

It is to be noted that in several cases the fungus of tinea flava has apparently a deep permanent disturbing action on the pigmentation processes of the

skin, as, even when the fungus has been destroyed, the patches may remain of a lighter colour than the surrounding skin for a long time, though ultimately they become again normally pigmented.

TINEA NIGRA.

Synonyms.—Pityriasis Nigra (Castellani), Microsporosis Nigra (Castellani).

This affection is fairly common in India, Ceylon, Java, Federated Malay States, and China. The first account of this, or a very similar, dermatomycosis was published by Manson in China in 1872. Manson's observations, however, were forgotten, as they were not quoted by him in his subsequent works. Castellani, in 1905, redescribed the disease in Ceylon, and succeeded in growing the fungus.

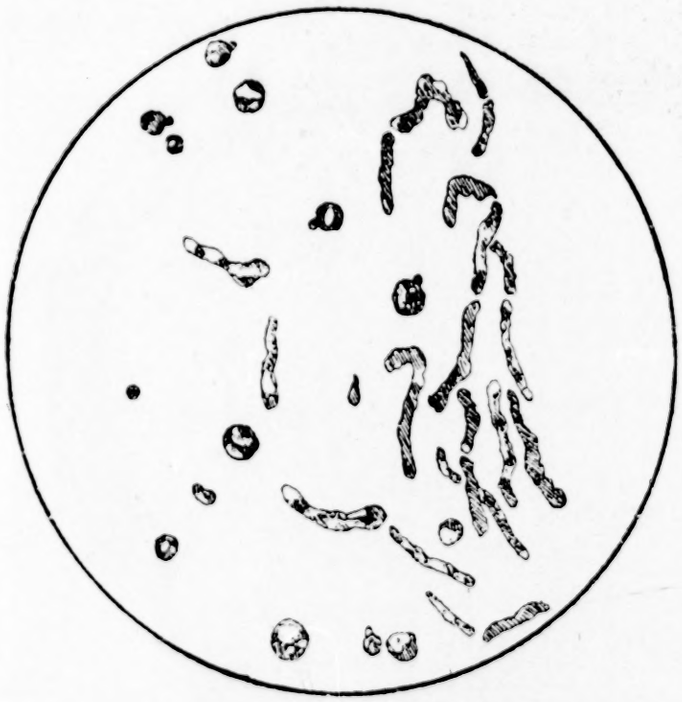

FIG. 576.—FUNGUS OF TINEA NIGRA.

Ætiology. — The affection is caused by a fungus of the genus *Cladosporium*—*C. mansoni* Castellani 1905. The fungus is found very abundantly in the lesions; the mycelial elements are rather short—18 to 20 μ in length, and $2\frac{1}{2}$ to $3\frac{1}{2}$ μ in breadth. Sometimes they may be irregular in outline, bent, banana-shaped. The spores are globular, and most of them very large—5 to 8 μ. They are frequently arranged in clusters.

The fungus is easily cultivated by inoculating scrapings of the affected patches on maltose agar. After two to four days roundish hemispheric colonies appear, which are black, but at first have usually a greenish tinge, and may present at the periphery some radiating, delicate, pale greenish hyphæ. These colonies may remain separate or more often gradually coalesce into a jet-black knobby mass, deeply rooted into the medium.

The fungus grows well, though less abundantly, on the other sugar agars, and also on ordinary agar. In *broth* and *peptone-water* the growth is very slow, and takes place at the bottom of the tubes, with formation of a black or greenish-black sediment.

The *optimum temperature* for the growth of the fungus is between 30° and 32° C.; above 35° C. and under 25° C. the growth is much slower, and may be nil under 20° C. Further details on the fungus may be found on p. 837.

Symptomatology.—The affected parts are of a black, dull, lustreless colour, much darker than the surrounding dark, healthy skin

PLATE XI.

TINEA FLAVA ON THE FACE AND
TINEA NIGRA ON THE NECK.

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of the native. The patches may be small, roundish, and separated from one another, or may coalesce; the patches are often slightly elevated, and may present a slight desquamation. Little, if any, pruritus is present. The face is not usually affected, though the eruption may be found on practically any other region of the body. The neck and upper portion of the chest are apparently the regions most frequently affected. Tinea nigra usually attacks natives. We have, however, seen it also in one of our European patients, who went for a pleasure trip to Burma, where he remained about a month. On coming back to Ceylon, he noticed a small, roundish, very slightly elevated, non-desquamating, black patch on the palm of his left hand. There was no pruritus. The patch spread slowly for two months, reaching the size of a sixpenny-piece. It disappeared after a single application of formalin; three months later it reappeared in the same place as a tiny black dot, which slowly spread. Another application of formalin caused it to again disappear. From the patch a fungus was grown identical with the one found in native cases.

Mixed Infections.—A mixed infection of tinea nigra and tinea flava is somewhat frequently met with. Several of our patients had on the neck a few round patches of tinea nigra, and on the face some smooth, yellow, roundish patches of tinea flava.

Diagnosis.—The characters of the fungus, and the fact that the disease is very easily curable, readily distinguish tinea nigra from pinta. Pityriasis versicolor is generally of lighter colour than tinea nigra, and the fungus (*Malassezia versicolor*) is morphologically very different, and cannot be grown. In chloasma bronzinum no fungus is found.

Treatment.—The disease is easily curable, except when it attacks the palms of the hands, where the treatment must be more prolonged. A salicylic-alcoholic lotion (2 per cent.), followed by a resorcin ointment (resorcin, ʒi.; vaseline, ʒi.) answers well. When the patches are small, pure formalin may be used with care.

ERYTHRASMA.

This affection is frequently met with in the tropics, and is common on the continent of Europe, though apparently rare in America.

Ætiology.—It is caused by a fungus discovered by Burckhardt in 1859—*Nocardia minutissima*. This hyphomycete is very delicate and slender, less than 1 μ in breadth; is found in the superficial horny layer of the affected parts. Ducrey and Reale claim to have succeeded in cultivating it, but their results have not been confirmed.

Symptomatology.—The eruption generally affects the genito-crural and axillary regions, but may occasionally spread to other parts of the body. It is characterized by the presence of brownish-reddish patches, rounded or irregularly shaped, but with well-defined

borders. The borders are not elevated; the surface of the patches appears slightly furfuraceous, and has often a somewhat greasy feeling. There are no subjective symptoms, except occasionally slight itching.

Diagnosis.—Erythrasma is easily distinguished from tinea versicolor and tinea flava by the reddish tinge generally present; by the characteristic difference of its sites of development, and by the microscopical examination which will reveal the presence of *Nocardia minutissima*, a fungus morphologically very different from *Malassezia versicolor* or *M. tropica*. The differential diagnosis from tinea cruris has been discussed in this chapter under the heading Tinea Cruris.

As first noticed by Manson, after tinea cruris has been cured, the genito-crural region may in some cases present for years a peculiar brownish discoloration, and be slightly furfuraceous—a condition resembling erythrasma; in such cases neither *Epidermophyton cruris* nor *Nocardia minutissima* will be found.

Treatment.—Washing the parts with ordinary soap and warm water, carbolic, tar, or sand-soap, and then regularly applying a resorcin-salicylic ointment (resorcin, gr. x. to xxx.; ac. salicyl., gr. x. to xx.; vaseline, ʒi.), will soon cause the eruption to disappear. Instead of the ointment, a hyposulphite of soda (1 drachm to 1 ounce) or sulphurous acid lotion may be used.

BLASTOMYCOSIS.

Synonyms.—Saccharomycosis Hominis, Oidiomycosis, Dermatitis Blastomycetica, Blastomycetic Dermatitis, Zymonematosis.

Definition.—The term blastomycosis covers a group of closely allied pathological conditions due to fungi of the genera *Saccharomyces*, *Cryptococcus*, *Coccidioides*, and *Monilia*, generally characterized by the presence of warty patches and minute epidermal abscesses.

Historical and Geographical.—Wernike, in 1890, described in Buenos Ayres two cases of papillomatous eruption in which he found peculiar bodies which were at first considered to be protozoa, hence the disease was called 'protozoic dermatitis.' Later Gilchrist and Ophuls showed them to be vegetal parasites. Gilchrist, in 1894, described yeast-like organisms in sections taken from a scrofuloderma-like eruption. In the same year, independently, Busse and Bushke published a case of a pyæmia-like condition due to a *Saccharomyces*. The disease has been investigated chiefly by American observers, among whom Ricketts, Ormsby, Hyde, Montgomery, and Pusey may be mentioned. The malady occurs in the tropics, and one of us has reported several cases from Ceylon, while Phalen and Nichols have described numerous cases from the Philippine Islands, Léger two cases in Tonkin, and Lutz, Splendore, and others, cases from South America.

Ætiology.—The fungi found belong to the genera *Saccharomyces, Cryptococcus, Coccidioides, Monilia*, including in the last-mentioned genus the following non-sufficiently defined genera: *Zymonema, Parasaccharomyces, Parendomyces*. There are also higher, not yet well-determined fungi, all of which are apparently capable of inducing identical clinical conditions. In the tissues all the organisms exist as yeast-like, oval, or roundish cells.

Among the organisms which cause the disease, Ricketts distinguished four types:—

1. Blastomycetoid or yeast-like type: reproduction by budding; in cultures only oval or roundish cells are seen, while mycelial tubes are as a rule absent.
2. Cryptococcus-like type: reproduction by endosporulation within the tissues.
3. Endomyces-like type: the cultures present abundant submerged mycelium, which breaks up into chains of endoconidia; proliferation by budding is rare.
4. Hyphomycetoid type: cultures present aerial hyphæ and submerged mycelium; proliferation by gemmation occasionally seen. There are many transition forms between these four groups.

FIG. 577.—BLASTOMYCOSIS OF LEG.

Histopathology.—There is marked proliferation of the epithelial layers, with elongated, irregularly shaped downgrowths into the corium, and epithelial globi are seen. The cells of the rete are swollen, and there is, between the cells, a polymorphonuclear leucocytic infiltration. Here and there minute miliary abscesses are present. In these, numerous polymorphonuclear and mononuclear leucocytes are found, also epithelioid cells and giant cells, some containing the parasite. It is in the miliary abscesses that the organism is mostly found. The corium presents a general cellular infiltration made up of polymorphonuclear leucocytes and young connective-tissue cells. The vessels are dilated and their walls thickened. Splendore has noted that when the lymphatic glands are affected, which is of rare occurrence, they may present histologically a tubercular appearance.

Symptomatology.—The disease, as seen by us in Ceylon, is characterized by the presence of elevated warty patches showing, especially at their margins, minute epidermal abscesses, and often small ulcers covered by yellowish crusts. The eruption may be gyrate. The lesions at a later stage may become more deeply

ulcerated, the process of ulceration generally beginning at their centre. There is very little or no pain, and very slight or no pruritus. The lesions may heal spontaneously, leaving, as a rule, soft smooth scars. Occasionally the affection recommences after a time in the scar. The lymphatic glands are not often involved. In some cases subcutaneous abscesses and gumma-like swellings may be formed. All regions of the body may be affected. The course is very chronic, the disease lasting often for many years.

Clinical Varieties.—Several varieties can be distinguished :—

1. The common cutaneous type, or North American and Asiatic type.
2. The oro-pharyngeal blastomycosis.
3. The Coccidioides blastomycosis.
4. The gluteal blastomycosis.

1. *Common Cutaneous Type.*—The description we have given of the disease refers to this type, which is quite common in Ceylon,

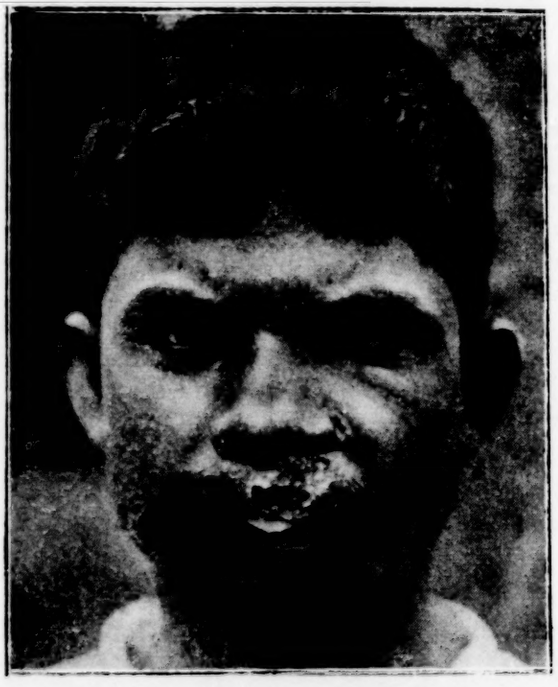

FIG. 578.—BLASTOMYCOSIS OF THE UPPER LIP : ULCERATIVE STAGE.
(From a case in the Colombo Clinic.)

FIG. 579.—BLASTOMYCOSIS OF THE MOUTH.
(From a photograph by Splendore.)

Southern India, Philippine Islands, Indo-China, Tonkin, and probably in many other parts of the tropics. A very frequent localization in Ceylon is the upper lip (see Fig. 578), the disease extending later occasionally to the nasal mucosa, and very rarely to the oral mucosa. In several of our cases a monilia-like fungus was grown.

2. *Oral Blastomycosis.*—This variety has been investigated by Lutz and Splendore in South America. Splendore considers the fungus to be a *Zymonema*, and calls the disease zymonematosis.

As most authorities do not accept the genus *Zymonema*, we place the fungus in the genus *Monilia* (see Chapter XXVIII.). The skin lesions are identical with those found in the common type of the malady, but the infection spreads to the oral mucosa, lips, gums, soft and hard palate, giving rise to numerous small verrucoid papillomatous or framboesiform patches, which later may undergo deep ulceration. The disease later invades the pharynx, nose, larynx, and bronchi, and often terminates fatally.

FIG. 580.—BLASTOMYCOLITIC ULCER.
(From a photograph by Splendore.)

3. *Blastomycosis Coccidioides* (synonym, Protozoic disease) was described by Wernike of Buenos Ayres in 1890, and later by Posadas; it was further investigated by Ophüls, Moffit, and others. It was at first considered to be of protozoal

FIG. 581.—BLASTOMYCOSIS GLUTEALIS.
(From a case in the Colombo Clinic.)

origin. The lesions on the skin are somewhat similar to those found in the more usual type of blastomycosis—viz., verrucose patches with minute epidermal abscesses, but are generally of larger size, and visceral complications are the rule, the malady termina-

ting almost always fatally. In the affected tissues peculiar large structures are seen, some of which may contain as many as 100 spore-like bodies (see chapters on Fungi, p. 771).

4. *Gluteal Blastomycosis.*—This condition was described by Kartulis some years ago in Egypt. We have often observed it in Ceylon. The skin of the gluteal region—one nate or both nates—presents a diffuse induration, and is cribrated with the opening of sinuses, from which a thin pus exudes. The sinuses may be very deep and connected with each other, but in our cases did not communicate with the intestine. The pus does not contain grains, as is the case with actinomycosis. The patient may complain of pain and discomfort on sitting down. The disease is chronic.

Maxwell has reported from Formosa cases of a fistulous disease of the buttocks, which may be of the same nature. He is inclined, however, to consider them to be of amœbic origin.

Diagnosis.—This is based, in the usual type of the malady, on the presence of verrucose patches with micro-abscesses, in which the fungi are found. The disease has been often confused with tuberculosis verrucosa, with a syphilide, with an epitheliomatous lesion, and, in the tropics, with atypical framboesia and even ringworm. The microscopical examination and cultivation of scrapings, or, better, of the pus of the miliary abscesses present in the lesions, will be necessary to clear the diagnosis. A droplet of the pus, or a minute portion of teased tissue, is placed on a slide with a drop of a 30 per cent. solution of potassium hydrate, and a cover-glass is placed on the preparation; after about half an hour in a temperate climate, and generally a few minutes only in a tropical climate, the tissue and pus cells are disintegrated by the potash solution, while the organisms, being resistant, can be easily seen. Cultures should also be made from the pus. It is important to note that yeast-like organisms may be frequently found as saprophytes on the surface of various ulcerated skin lesions, which have nothing to do with true blastomycosis.

Oral blastomycosis may occasionally be confused with espundia, from which it is differentiated by the absence of Leishmania and presence of fungi. *Blastomycosis coccidioides* is easily diagnosed by the presence of bodies containing numerous—as many as 100—endospores. *Gluteal blastomycosis* is distinguished from actinomycotic and mycetomatous conditions by the absence of the grains and the characters of the fungi; from a syphilitic condition by the inefficacy of a mercurial treatment; from tubercular fistulous disease by the massive diffuse induration, and absence of tubercular cutireaction.

Prognosis.—The disease very rarely heals spontaneously. The general health in the common type of the malady is not much affected, but the patients complain of the disfigurement. Occasionally the organisms from the skin lesions enter the general circulation, and a condition similar to pyæmia develops. Cases of

systemic blastomycosis terminating fatally, without any skin lesion, have also been described. The prognosis of blastomycosis coccidioides and oral blastomycosis is bad, while blastomycosis glutealis is most persistent, though the general health is not much affected.

Treatment.—Potassium iodide, given in large doses (gr. xv. to xx. three or four times daily), has a beneficial effect, though it is not so efficacious as in sporotrichosis. The application of Röntgen rays to the lesions is useful. In mild cases the local application of various disinfectants—*e.g.*, perchloride of mercury (1 in 1,000), diluted tincture of iodine, etc., may bring about a cure. The following ointment is useful, especially in the localization to the upper lip: Ichthyol, gr. xv.; ung. belladonnæ, ʒii.; vaselini, ad ʒi. No treatment is apparently of much use in blastomycosis coccidioides, in oropharyngeal blastomycosis, or in blastomycosis glutealis.

SPOROTRICHOSIS.

Schenk, in 1898, described a case of multiple chronic abscesses in the pus of which a *Sporotrichum* was found. Hektoen and Perkins reported two similar cases also in the United States in 1900. De Beurmann published in 1903 a case of similar nature in France. De Beurmann and Gougerot, from 1906 onwards, have published many cases, and have completely investigated the subject of human sporotrichosis bacteriologically and histologically, as well as clinically. Their researches have been confirmed by Gaucher and Monier-Vinard, Duval and Fago, Vaquez, Bonnot, Lambry, Adamson, Esmeni, and many others. Cases have been reported recently from the tropics by Lutz and Splendore in Brazil, and by us in Ceylon. Clair has observed the disease in Arab stokers on board some steamers of the Messageries Maritimes Company.

Ætiology.—The fungi causing the disease belong to the genus *Sporotrichum* Link 1809, of which eight species have been so far described in man:—

Sporotrichum Link 1809
- *S. schenki* Hektoen and Perkins 1901.
- *S. beurmanni* Matruchot and Ramond 1905.
- *S. dori* de Beurmann and Gougerot 1906.
- *S. gougeroti* Matruchot 1910.
- *S. jeanselmei* Brumpt and Langeron 1910.
- *S. indicum* Castellani 1908.
- *S. asteroïdes* Splendore 1909.
- *S. lesnei* Vuillemin 1910.

For the description of these organisms, see chapters on Fungi (p. 831).

The species so far found in the tropics are—*S. beurmanni* Matruchot and Ramond in Brazil and Africa, *S. asteroïdes* Splendore 1909 in Brazil, and *S. indicum* Castellani 1908 in Ceylon. These fungi are morphologically very similar. In the human lesions the fungus appears morphologically as a yeast, and is very scarce. In cultures

mycelial threads and numerous spores are seen. The spores are ovoid, 5 to 6 μ in length by 3 to 4 μ in breadth. The mycelial filaments are very slender (2 μ) in *S. beurmanni* and *S. schenki*; somewhat broader ($2\frac{1}{2}$ to 3 μ) in *S. indicum*. *S. asteroïdes* is characterized by the presence of peculiar radiate bodies in the affected tissues. These fungi grow easily on the ordinary culture media, best of all on Sabouraud's peptone-glucose agar. Colonies develop from the fourth to the tenth day as small white points, surrounded by a delicately rayed aureola of whitish colour. They gradually increase in size, coalesce, become convoluted, and take a dark greyish, brownish, and even black colour. These fungi live apparently saprophytic on vegetables (lettuce-leaves, and other kinds of vegetables used as salads) and on insects (flies, caterpillars, larvæ). According to De Beurmann, infection takes place by contact

FIG. 582.—SPOROTRICHIC LYMPHANGITIS.
(From a photograph by Splendore.)

with unclean vegetables. The fungi may also, apparently, live saprophytically in the oral cavity and pharynx of certain individuals, who then become carriers.

The rat, mouse, monkey, cat, and very young guinea-pigs, are all more or less susceptible, and may be infected by subcutaneous or intraperitoneal inoculation. The rat is the most susceptible animal. In it Lutz and Splendore have described a spontaneous sporotrichosis due to a *Sporotrichum* apparently identical with *S. beurmanni*. The affection has also been observed to occur spontaneously in the dog (Gougerot and Caravan) and in the mule (Fonteynot and Carongeau) in Madagascar.

Histopathology. — The histopathology of the cases due to *S. beurmanni* has been investigated by De Beurmann and Gougerot; that of the cases due to *S. asteroïdes* by Splendore; that of the cases due to *S. indicum* by ourselves. Whatever the causative species of *Sporotrichum*, the histological lesions are apparently the same, and correspond to the three principal types described

by De Beurmann and Gougerot—viz.: (1) An epithelioid type, with presence of giant cells—this corresponds to the tuberculoid type of De Beurmann and Gougerot; (2) a lympho-connective tissue or syphiloid reaction; (3) a polymorphonuclear or a ecthymatiform type.

Symptomatology.—In a well-marked case, several gummatous-like swellings, situated in the subcutaneous tissue, are present on various parts of the body—the arms, legs, and trunk. The size varies from that of a small pea to that of an orange. On palpation, they are hard, resistant at first; later they soften, the skin becomes reddish or violaceous, and after a time perforates. From the fistulous opening a yellowish homogeneous pus is slowly evacuated. or at times a thin serous discharge. In some cases the suppuration ceases, granulation sets in, and a coarse cheloid-like scar remains. In other cases the fistulous opening enlarges and a crateriform ulcer, with often a fungating fundus, develops. The lymphatic glands may occasionally become affected. The course of the disease is very chronic. In some cases deep gummata develop under the periosteum of various bones, and in the muscles. Large granulating ulcerations may form in the buccopharynx and larynx. The general health, as a rule, is not much affected.

Clinical Varieties.—The commonest varieties met with are:—

1. The localized type, with sporotrichic chancre and ascending sporotrichic lymphangitis.
2. The disseminated gummatous type.
3. The disseminated ulcerative type, presenting often polymorphic lesions—viz., syphilitic-like, tubercular-like, ecthymatous, rupial, furuncular.
4. The extracutaneous type, with sporotrichic lesions of the mucous membranes, the muscles, the articulations, the bones, the organs of special sense, the internal organs—lungs, kidneys, etc.

De Beurmann has put on record a case of mycetoma of sporotrichic origin. Cases of systemic sporotrichosis have been described.

Diagnosis.—The principal clinical signs on which to base a *probable* diagnosis of sporotrichosis are the presence of gumma-like lesions while the patient is in a good general state of health; the mixture of lesions of different appearance; partial cup-shaped softening of the nodes, breaking down in the centre and ending in ulceration, with violaceous edges generally undermined; presence of viscous pus or of a serous lemon-yellow discharge; indolent evolutions; absence in most cases of enlarged glands. The definite diagnosis can only be made by bacteriological methods. The simple microscopical examination of the pus of the abscesses, or scrapings of the ulcers, is not sufficient, as the fungus is extremely scarce. Cultivation must be resorted to. A few glucose-agar tubes are inoculated in the usual way, and kept at room-temperature without capping. After four to ten days the first colonies of *Sporotrichum* will appear.

Treatment.—Potassium or sodium iodides in full doses (15 to 20 grains three to four times daily), well diluted in water or milk, induce a rapid disappearance of all the lesions. In persons who cannot take potassium iodide, saiodin in the same dose may be given in cachets. The ulcerated lesions may be dressed with a lotion of potass. iodide 10 parts, iodine 1 part, water 500 parts. Surgical measures should be avoided.

Prophylaxis.—Any small wound should be disinfected with tr. iodi.

SACCHAROMYCOSIS EPIDERMICA.

In Ceylon and Southern India it is not rare to observe on the arms and, occasionally the chest, of Europeans, small, roundish patches of a dirty yellow or brownish colour, which can be removed by thorough scraping. These patches consist of large numbers of blastomyces-like elements of various size—roundish or oval—which so far have not been cultivated.

INTERTRIGO SACCHAROMYCETICA.

Synonym.—Intertrigo Blastomycetica.

Remarks.—Cases of this affection have been observed by Castellani in Ceylon, and similar ones have been reported by Whitfield and others in Europe. The affection is apparently rare. It generally attacks the scroto-crural and axillary regions. The affected skin is red, and there may be slight exudation. The borders of the eruption are fairly well marked, but never elevated. In most cases there is not much itching, and the affection may recover spontaneously.

Ætiology.—In scrapings a *Saccharomyces* (*S. samboni* Castellani 1907), which is easily cultivated on sugar media, is found.

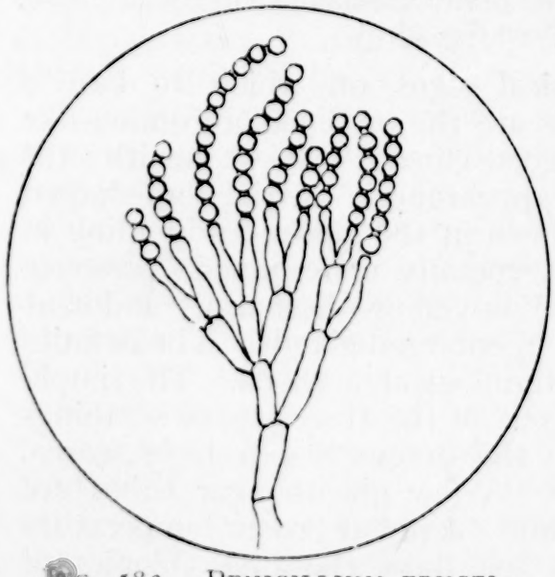

FIG. 583.—PENICILLIUM FRUCTIFICATION.

Treatment.—The treatment consists in washing the affected parts with potassium permanganate lotion, 1 in 4,000, or resorcin, 1 in 100 ; followed by the application of powders of boric acid ʒi., talci ʒi. ; or salicylic acid gr. x., talci ʒi.

ASPERGILLOSIS AND PENICILLIOSIS OF HAIRY PARTS.

The affected hairs—generally those of the beard and moustache, occasionally of the axilla—present dirty greyish or

whitish punctiform formations, which on microscopical examination are seen to consist of penicillar or aspergillar fungi (*Penicillium barbæ*, *Aspergillus barbæ*). Occasionally both types of fungi are found on the same patient. The affection is very chronic. The diagnosis is easy, the characteristic aspergillus and penicillium fructifications distinguishing this condition from other parasitic nodular affections. The simplest method of treatment is by shaving, and afterwards using regularly a medicated soap, such as carbolic soap, tar soap, or sulphur soap. If the patient does not wish to shave his beard, turpentine may be tried.

In natives who do not bathe frequently, such as old persons and beggars, the skin presents often large dark patches due to accumulated dirt, in which aspergillar and penicillar fungi are often present, living saprophytically. This condition has nothing to do with pinta, as a thorough scrubbing with soap will remove the dirt and the aspergillar and penicillar fungi which may be present.

PINTA.

Synonyms.—Mal de los Pintos, Mal del Pinto, Caraate, Tina, Quirica, Pannus Carateus (Alibert), Tache Endémique des Cordillières (Alibert), Lota, Cativi.

Definition.—The term ' pinta ' does not indicate a single disease, but a group of closely allied dermatomycoses characterized by the presence of patches of various colour, due to different species of fungi of the genera *Aspergillus*, *Penicillium*, *Monilia*, and *Montoyella*.

History.—The disease first began to draw the attention of medical writers in the eighteenth century, though it was apparently well known to the inhabitants of the affected regions since remote times, as it is found to have formed the subject of prayers and supplications used by the Aztecs, centuries before the Spanish Conquest.

A short description of the malady is found in the Encyclopædia of Polanko, of Mexico, in 1760 ; and in Juan de Velasco's ' Historia,' in 1789, in Columbia. Velasco believed the malady to have been imported by African slaves. A fairly complete description is given by Alibert, in 1829, under the name of ' tache endémique des Cordillières,' or ' pannus carateus.' Among the modern authors, the clinical and pathological investigation of Gomez, Uribe, Vribechyel, Iryz, Ruiz y Sandoval, Gastambide, may be mentioned.

More recently the investigation into the ætiology of pinta by Montoya has been of the greatest importance.

Climatology.—Pinta is practically limited to tropical America, where it is found in Venezuela, Peru, Chili, Central American States, Mexico. Cases have been reported from Brazil. It is extremely common in Columbia, where, according to Montoya, 4 per cent. of the total population is affected. There the patient affected with the disease is called ' caratejo.' The disease is not equally distributed in each country there are localities where the disease is common, while other districts are almost unaffected. In Columbia

it is the northern province of Santander which is more particularly affected; in Mexico the disease is most frequently found in the provinces of Tabaxo, Chiaspas, Valladolid, Michoacan.

A few cases of pinta have been reported from Egypt by Madden, Goodman, and Sandwith, and previously Legrain described somewhat similar cases from Tripoli and the Sahara. Legrain, however, did not find any fungus. A few isolated cases have also been reported from the Gold Coast, and others from the Philippine Islands by P. G. Woolley. In Ceylon and India only imported cases are seen.

Ætiology.—Previously to Ruiz y Sandoval and Montoya's investigations the disease used to be ascribed to many different causes. Some authors believed it to be due to the mineral salts (sulphates) contained in the waters of the mines and other localities where the malady is endemic; others considered it to be due simply to insanitary conditions, insufficient food, and a hot and damp climate; others, again, believed the affection to be induced by the action on the skin of volcanic cinders; while, according to some authorities, the malady was a hereditary complaint.

Ruiz y Sandoval, in Mexico, first detected the parasitic nature of pinta. He believed there was only one species of fungus to be found in the affection, and that the different colours of the patches were due to the different depths at which the fungus was growing in the various strata of the epidermis. Montoya's classical researches in 1898 clearly showed the plurality of species and genera of the fungi found in the disease, and demonstrated that each variety of pinta is due to a different fungus. More than twenty different species were found by him.

In the present state of our knowledge of pinta it is impossible to give a satisfactory classification of these fungi. The principal ones may be collected into the following groups:—

I. Fungi of genus *Aspergillus*: *Aspergillus pictor* Blanchard 1895, and several other species. *A. pictor* is found in the pure violet variety of pinta; the other species are observed in the pure blue and bluish and violet-black varieties, as well as in a form of the red variety. Several of these species are not in reality true *Aspergilli*, as they possess organs of fructification intermediate between those of the genus *Aspergillus* and those of the genus *Penicillium*.

II. Fungi of genus *Penicillium*: *Penicillium montoyai* Castellani 1907, and several other species. They are found in some greyish-violet varieties of pinta.

III. Fungi of genus *Monilia*: *Monilia montoyai* Castellani 1907. Found in some cases of white pinta.

IV. Fungi of genus *Montoyella*: *Montoyella nigra* Castellani 1907. Found in one variety of black pinta. *M. boxini* Castellani 1907. Found in a red variety of pinta.

The term *Aspergillus* (*Trichophyton*) *pictor*, introduced by Blanchard in 1895, when the plurality of species of the fungi found in pinta had not yet been demonstrated, is now used in a restricted sense to indicate the *Aspergillus* found in the pure violet variety of the disease.

Montoya believes that the fungi found in Columbian pinta, or caraate, are different species from those found in Mexican pinta.

Appearance of the Fungi in Fresh Preparations.—Scrapings from the patches examined in liquor potassæ show in most cases between the epithelial cells long dichotomous mycelial threads, from which shorter and thicker branches take origin at various points. These thicker branches terminate in comparatively large fructifications. The morphological characters of these fructifications vary according to the species and genus of the fungus present. They may be typical aspergillar or penicillium-like fructifications, or they may show intermediate characters between those of *Aspergillus* and *Penicillium*. In many cases the fructification organ is represented by a pear-shaped or triangular formation, surmounted by five to six rods (sterigmata), each of which supports a string of five to six spores. The number of these spores, however, may vary. They are globular, have a smooth surface, show a double contour, and their diameter is much larger than that of the mycelial tubes.

In the cases where the fungus present is a *Monilia* or a *Montoyella*, such or similar fructifications are absent, and only mycelial tubes and some scattered spores are seen.

Cultures.—The various fungi found in pinta are easily cultivated, the best medium being Sabouraud's maltose agar. The *optimum* temperature is between 30° and 40° C.

The composition of Sabouraud's medium is :—

Maltose	4 grammes.
Pepton (Chassaing)	1 gramme.
Agar	1.5 grammes.
Distilled water	100 c.c.

Culturally, the fungi may be divided in five groups :—

1. Those showing in cultures aspergillar fructifications.
2. Those showing penicillium fructifications.
3. Those showing intermediate fructifications between the *Aspergillus* and the *Penicillium*.
4. Those showing simpler fructifications characteristic of the genus *Monilia*—viz., a mycelial thread terminating in a single string or small bunch of roundish spores.
5. Those in which higher organs of reproduction are absent, and reproduction takes place somewhat similarly to what is observed in the genera *Microsporon* and *Trichophyton*—by conidia and terminal segmented and unsegmented 'spindles.' The fungi of this group, found by Montoya in a variety of black pinta, by Bodin, and later by Castellani, in a variety of red pinta, constitute the genus *Montoyella*.

Inoculation Experiments.—Montoya has tried to infect rabbits using various cultures of the fungi found in the disease. On several

occasions a desquamation of skin and loss of hair was observed, and some chromatic patches appeared. Uribe succeeded in inoculating several mulattoes.

According to Montoya, the fungi of pinta live saprophytically in certain waters, especially in those of mines and localities where the temperature is constantly high. He states that he obtained pure cultures of the pinta fungi direct from such waters. He has also found the same fungi as ectoparasites on the bodies of mosquitoes of the genus *Culex*, on sandflies (*Simulium*), and on the body of some bugs (*Clinocoris*), which are very common in the mines. He believes, therefore, that mosquitoes and other insects play a rôle in the transmission of the disease.

In some old chronic cases of pinta an *Acarus*—somewhat resembling *Acarus scabiei*, though larger—has been found to live in the epidermal squamæ, and some writers believe that this *Acarus* also plays a part in the transmission of the malady.

Predisposing Causes.—What the older authors believed to be the true causes of pinta—viz., a hot, damp, climate; insanitary surroundings and poor feeding; the mineral salts contained in the waters—are only predisposing causes, some of which, however, are of great importance. The hot, damp climate favours the growth of the fungi; the water of the mines, which contains a large amount of mineral salts (especially sulphates), produces after a time in those who use it for washing, etc., a dermatitis with fissures and other eczematous-like lesions which greatly facilitate the infection.

All races are liable to be attacked by the disease, but mulattoes seem to be particularly prone to become infected. Albinos are said to be immune. Both sexes are equally liable to become infected, though males, on account of their occupations, are more frequently affected. The malady generally appears between the age of fifteen and twenty-five, but it may appear at any age, and has been seen in children three or four years old.

It has been observed that individuals of the negro race are more liable to contract the black variety than any other kind of the disease, while whites are especially liable to contract the red variety Miners and agricultural labourers are affected in most cases by the violet variety.

Symptomatology.—The disease begins very gradually. After an incubation period, varying, according to different authors, between a few weeks and some months, one or several small slightly pruriginous spots appear on uncovered parts of the body. The spots increase very slowly in size, and some may fuse together. They are roundish, or may have an irregular outline. At first they are hardly raised above the normal skin. The surface of the patches is generally dry and rough, and is covered with fine pityriasic squamæ in recent cases, with larger and thicker scales in older ones. Occasionally, in chronic cases, the surface of the patches, instead of being dry, may be moist or somewhat greasy or glutinous.

The hairs of the affected regions become atrophied, and later on fall out. The shedding of hair is not due to the fungi invading directly the hair ; it is due to a peculiar fibrosis of the hair follicle, at the place of the hair a hard formation remaining, like a grain of sand (fibroid folliculitis of Montoya).

Pruritus is generally well marked, especially at night-time. There are often patches of hyperkeratosis in the palms and soles, and the normal lines and sulci appear much deeper.

Old chronic cases occasionally exhale a peculiar musty odour, which has been compared to the smell of cat's urine, or to the bad smell of dirty linen kept in a warm, damp place.

The affection may spread to the whole body, except the palms of the hands and the soles of the feet. The nails are never attacked. The scalp is not usually affected.

The disease has no tendency to spontaneous cure. Its course is very chronic, and may last the whole of the patient's life.

Some of the older authors state that the patients during the incubation period suffer from fever, vomiting, and diarrhœa. Montoya says that pinta patients have not got an odour *sui generis*, as stated by most observers. In cleanly patients no smell whatever is noticeable, apart from the peculiar odour of the negro race.

Clinical Varieties.—Clinically, six different varieties may be distinguished, each of which shows several subvarieties :—

1. The Black Variety.
2. The Blue Variety.
3. The Violet Variety.
4. The Red Variety.
5. The Yellow Variety.
6. The White Variety.

Black Variety.—The patches are of a black colour, and are very often found on the face, though they may be present on any other part of the body except the palms and soles, similarly to all the other varieties. The patches are hardly raised, and their surface is slightly desquamating. Pruritus is generally complained of, but is not, as a rule, so unbearable as in the other varieties. Black pinta is found in negroes more frequently than in individuals of Caucasian race. The course is very chronic. The treatment is difficult, though not so difficult as in the other varieties.

Black pinta shows two subvarieties—one is characterized by the presence of patches of a black-violet colour ; the other by patches of jet-black, indian-ink black colour. The fungus found in the first is an *Aspergillus* (species undetermined) ; in the second a *Montoyella* (*M. nigra*).

Blue Variety.—This is much less frequent than black pinta. The patches are of a blue colour. They generally begin to appear first on the dorsum of the hands, and then tend to spread over the whole body—uncovered as well as covered parts. There generally is intense pruritus.

The fungus usually found in blue pinta is *Aspergillus*.

Violet Variety.—Apart from the colour of the patches, which is violet, the clinical symptoms and course of this variety are identical with those of blue pinta. It is extremely common among rural labourers and miners.

There are numerous subvarieties of violet pinta. In some cases the patches are of a pure violet cure; in other cases the colour may be violet-greyish, violet-brownish, violet-purplish. There are cases in which the patches are at first of a greenish colour, to become violet-bluish later on. The fungus found in the pure violet pinta is an *Aspergillus* (*A. pictor* Blanchard 1895); the fungus found in the violet-greyish cases is a *Penicillium*—*P. montoyai* Cast. 1907; the fungi found in the other varieties are *Aspergilli* or fungi presenting transition characters between the *Aspergillus* and the *Penicillium*.

Red Variety.—This is the commonest variety found in white patients. The patches first develop, as a rule, on the dorsum of the hands and feet, and spread to large portions of the body. The patches are red — often brick-red — and usually show a rather abundant desquamation. Pruritus is very distressing, especially at night-time. Secondary lesions due to scratchings and inoculation of pyogenic micro-organisms are not rare. Ulcerative lesions have been reported by several observers as occasionally occurring.

In some cases of red pinta an *Aspergillus* (species not determined) is found; in others a fungus of the genus *Montoyella*, *M. bodini* Cast. 1907, found by Bodin in 1903 in a patient who was under the treatment of Darier.

Castellani, in 1907, found the same or a very similar *Montoyella* in a case of red pinta observed in a European sailor who had long been in tropical America. In this case the disease had not yet spread much. Besides the red patches, there was on the right forearm a small greyish-violet spot, in which a fungus was found, which gave *Penicillium* fructifications in cultures (*P. montoyai*).

Red pinta is more serious than any other variety, as it affects not only the superficial strata of the epidermis, but the rete Malpighii as well as the corium.

Yellow Variety.—Very common among half-castes. It generally begins on the chest or arms. The patches are yellow, and at first are not pruriginous and not desquamating. In old cases, however, there is pruritus. This variety is very frequently mixed with patches of white pinta, and is difficult to cure. The fungi found belong to the genera *Monilia* and *Aspergillus*.

White Variety.—The patches are of a dull white colour, and are generally very large. The surface is usually rough and desquamating, but at times it may be smooth. In some cases a fungus of the genus *Monilia* is present, but, according to Montoya, in other cases no fungus whatever is to be found. Montoya considers the white variety of pinta to represent in many cases the ultimate retrogressive stage of all the other varieties except the red. The patches

of white pinta would be in such cases in reality unpigmented, leucoderma-like areas due to the disturbing action of the various fungi on the pigmentation processes of the skin.

Montoya's belief on the nature of white pinta in some cases is supported by Castellani's observations on tinea flava and tinea alba. In both these dermatomycoses white, pseudo-leucodermic patches may occasionally be seen long after the fungus had died out, and these patches may remain unpigmented for months and years.

Mixed Variety.—Not infrequently the same patient may be affected with several varieties of pinta, presenting a grotesque tattooed or piebald appearance.

It is especially white pinta which is found associated with one or more of the other varieties.

Diagnosis.—This does not present any difficulty in the countries where the disease is endemic. In any doubtful case the microscopical examination, supplemented when necessary by the use of cultural methods, will clear the diagnosis.

Differential Diagnosis: Tinea nigra.—In contrast to the black variety of pinta, tinea nigra is very superficial, does not extend to large portions of the body, may attack the palms of the hands, is not pruriginous, is easily cured except when affecting the palms. The microscopical examination of scrapings from patches of tinea nigra will show mycelial tubes of irregular shape and large globular spores collected in bunches. The spores are grouped together in a somewhat similar manner to what one sees in pityriasis versicolor.

Tinea flava.—In contrast to yellow pinta, the fungus of tinea flava is a *Malassezia*, has the same morphological characters of the fungus found in pityriasis versicolor, and cannot be grown artificially.

Tinea albigena and Tinea alba.—These are trichophytic affections, and are easily distinguished by the characters of the fungi.

Leprosy can be distinguished from white pinta lesions by the sensibility not being impaired in pinta.

Only white pinta patches with no fungus might be mistaken for *leucoderma* on superficial examination. White pinta is very often associated with other varieties of pinta, which are easily diagnosed. Leucodermic patches are smooth, non-pruriginous, and the skin surrounding them is often hyperpigmented.

Prognosis.—Pinta, though not a fatal disease, must be considered a serious affection, as its course is chronic, and the treatment very difficult. In most cases the general health remains satisfactory, but the disfigurement is very distressing to the patients, who often become nervous and irritable. The pruritus, which is generally more marked at night, is also a cause of great distress and sleeplessness.

Treatment.—The popular treatment in Columbia is citrine ointment (mercury nitrate ointment). Other parasiticides have been tried, with a varying degree of success. When the eruption is at the very beginning, tincture of iodine may suffice. The best results

have been obtained by using chrysarobin (chrysarobin, gr. x. to xxx.; ung. zinci ox., ʒi.). This must be applied cautiously. When the malady affects large tracts of the body, only a portion should be treated at a time, to prevent as far as possible symptoms of absorption. The urine should be regularly analyzed during the treatment. The chrysarobin ointment must not be applied to the face, lest a severe conjunctivitis should develop. For the face a resorcin, or resorcin-sulphur, or resorcin-salicylic, or salicylic acid ointment (resorcini, gr. xxx. to ʒi.; ac. salicylici, gr. xv.; vaseline, ʒi.), is advisable, or citrine ointment may be used.

Montoya recommends chrysarobin dissolved in chloroform (chrysarobin 10 parts, chloroform 90 parts). Apply with a fine brush. When dry, apply gutta-percha dissolved in chloroform (gutta-percha 10 parts, chloroform 90 parts).

Chrysarobin may conveniently be applied in the form of a vernisol varnish (5 to 10 per cent.).

PIEDRA.

Synonym.—Trichosporosis Tropica.

Definition.—Piedra is a mycotic disease of some parts of South America causing very hard, small nodosities on the hair.

Historical and Geographical.—The condition has been known locally in Columbia since remote times, but the first scientific descriptions are due to Desenne (1878), Morris (1879), Osaria, and Megalhaes. More recently the condition has been studied by Juhel Renoy, J. M. H. MacLeod, Horta, and others. This disease of the hair is common in some districts of Columbia, especially the valley of Canca; but closely allied conditions are observed in several parts of the tropics, and occasionally in temperate zones (*piedra nostras*).

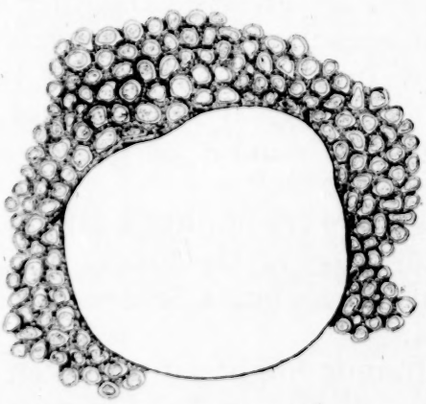

FIG. 584.—TRANSVERSE SECTION THROUGH A PIEDRA NODULE.

FIG. 585.—PIEDRA.

Ætiology.—If an affected hair is washed in ether, and then treated with liquor potassæ, and examined microscopically, the nodules will be seen to consist of large polyhedric refringent bodies, held together by an amorphous substance acting as cement. These bodies are the spores of the fungus causing the disease (*Trichosporum giganteum* Behrend 1890). The description of the fungus is given on p. 834. In Columbia it is generally believed that the infection takes place by washing the hair with a mucilaginous oil, much used by the women of the country. In British

Guiana natives consider it to be due to bathing in certain white or milky waters, while it does not occur if they bathe in the brown peat bush waters.

Symptomatology.—The hair of the head of women, and less frequently the hair of the head and beard of men, is affected. The affected hairs present strings of pin-head-sized nodosities, which are better felt than seen. The nodosities may be very numerous and are found on the surface of the hair-shaft, either on one side or surrounding it like a sheath. They are black and hard, though not so hard as the name piedra (stone) would imply, and a kind of crepitation is produced when the hair is combed. There is often matting and knotting of the hair. The disease is chronic, and the nodosities do not disappear spontaneously.

Horta has described a variety of piedra in Brazil, characterized by the nodules containing large cyst-like structures, which Pinoy considers to be probably asci (see p. 834).

Diagnosis.—The microscopical examination of the nodosities renders the diagnosis easy.

Prognosis.—The affection is of long duration, and has no tendency to spontaneous cure.

Treatment.—This is difficult. It has been recommended to apply benzene and turpentine to the hair, and to wash the head regularly with a perchloride lotion (1 in 2,000). In obstinate cases it is necessary to shave the head.

Trichosporosis Indica.

In India and Ceylon a condition similar to piedra is occasionally observed. It is, however, much less severe, a few minute nodules only being present on the hairs of the beard and moustache, and the hair of the scalp being rarely affected. The fungus seems to be different from that of the Columbian piedra.

Trichosporosis of Temperate Zones.

Cases of trichosporosis of temperate zones or piedra nostras (tinea nodosa), have been described by Beigel (1869), Caro, Behrend, Unna, Pick, Vuillemin. The nodosities in such cases have been found on the hairs of the moustache and beard, not on the hairs of the head. The fungi are slightly different from *T. giganteum*. Several species have been described—*T. beigeli* Rabenhorst 1867, *T. ovoides* Behrend 1890, *T. ovale* Unna 1896.

TRICHOMYCOSIS AXILLARIS FLAVA RUBRA ET NIGRA.

Definition.—A nodular affection of the hair, generally of the axillary regions, caused by a *Nocardia*, either alone or in symbiosis with chromogenic cocci.

Historical and Geographical.—Castellani in 1911 called attention to this nodular affection of the hair of the axillary regions, observed in natives and Europeans living in the hot, damp, districts of Ceylon. The condition will probably be found occurring in every low-lying tropical region.

Ætiology.—The researches of one of us have demonstrated that the yellow variety is due to a very thin, bacillary-like fungus, for which he proposed the name *Nocardia tenuis*. The black and red varieties are due to a symbiosis of this fungus with chromogenic cocci, a coccus producing black pigment (*Micrococcus nigrescens*) in the black variety, a coccus producing a red pigment in the red type.

Nocardia tenuis Castellani 1912.—The microscopic examination of the nodules reveals the presence of enormous numbers of bacillary-like bodies, which are Gram-positive, but not acid-fast. If the nodules are kept in alcohol or formalin for several months the fungus apparently loses partially or totally its property of being stainable by Gram's method. They vary in length, 4 to 10 μ and more; they are rather thin, 1 to 1½ μ; they may be straight or variously bent, occasionally branching; they are fairly closely packed together, and are embedded in an amorphous cementing substance. Attempts at cultivating the fungus have failed.

Characters of the Coccus-like Organism found in the Black Variety (*M. nigrescens* Castellani 1911).—It is a Gram-positive, rather large, non-motile coccus, which in certain media may take the appearance of a cocco-bacillus. Sugar media are more suitable for the growth of the organism than the ordinary agar.

Sabouraud Agar.—Colonies appear twenty-four to forty-eight hours after inoculation. They are roundish, at first white, but after a couple of days the centre of each colony turns black, and this pigmentation slowly spreads eccentrically. After a time the colonies coalesce into a jet-black mass.

Glucose.—Growth similar to Sabouraud but slightly less abundant. The black pigmentation develops from the centre of the colonies and slowly spreads towards the periphery.

Ordinary Laboratory Agar.—Growth much less abundant than on most sugar agars, and black pigmentation less marked.

Lævulose Agar.—Identical to glucose.

Saccharine Agar.—The pigmentation is less pronounced, and does not spread to the whole of the growth.

Raffinose Agar.—Same as saccharine.

Lactose Agar.—Scanty pigmentation.

Alkaline Maltose Agar.—Black pigmentation well marked, though in many cases it does not extend to the whole of the growth.

Acid Maltose Agar.—Growth less abundant than on acid maltose. Black pigmentation well marked.

Mannite Agar.—As alkaline maltose.

Inulin Agar.—As alkaline maltose, but pigmentation less pronounced.

Saccharose.—As inulin.

Glycerine Agar.—Abundant growth, the whole of which after a time becomes of jet-black colour.

Galactose.—As inulin.

Adonite.—Like acid maltose.

Serum.—Growth fairly abundant, but there is only a trace of pigmentation. The medium is not liquefied.

Gelatine.—No liquefaction. The growth on the surface shows after a time some dark pigmentation, but the colonies along the stab are white.

Milk.—No change.

Broth.—General turbidity. A thin pellicle is often present. The microscopical examination shows cocci arranged in pairs or irregularly. They are not capsulated.

Peptone Water.—Some growth at the bottom, while the rest of the tube is clear.

Sugar Broths.—No formation of acid or gas.

Indol.—Most strains produce a trace of indol.

Characters of the Coccus-like Organism found in the Red Variety of the Affection.—The coccus found in the red variety is more difficult to isolate and grow than the coccus observed in the black type of the affection. As a rule it grows better and shows more pigment on ordinary agar than on sugar media. It is non-motile and Gram-positive.

Agar.—The growth is at first white, then a red or red-yellowish spot appears in the centre. The pigmentation very slowly progresses towards the periphery, but, in my experience, never spreads to the whole of the growth; hence I was inclined for a long time to believe that I was growing two different cocci. Repeated plating, however, has convinced me that this is not the case. On maltose and glucose agar the same pigmentation is present, but on most of the other sugar media no pigment is produced. Gelatine and serum are not liquefied. This coccus, as already stated, is Gram-positive and non-motile.

The coccus is closely allied culturally to *Micrococcus ruber* of Trommsdorff, found in cases of chromidrosis, and also to *M. rubicus* of Hefferan. In none of our cases, however, was the condition associated with chromidrosis.

Symptomatology.—The affected hairs of the axilla present nodular formations, plainly visible to the naked eye, of rather soft

FIG. 586.—TRICHOMYCOSIS AXILLARIS FLAVA.

FIG. 587.—TRICHOMYCOSIS AXILLARIS NIGRA.

consistency. They are easily removed by scraping with a triangular needle or any similar instrument. The formations are either yellow or black, or, less frequently, red. They may be very abundant, and form a yellow, or black, or red sheath round the hair (Figs. 586 and 587). The same patient may have two varieties: The hairs of one armpit may show the yellow variety, while the hair of the other armpit may present the black type. Sometimes the

same individual hair may present some of the nodules yellow and others black, or, rarely, red. We have not yet observed all the three varieties present at the same time on the same patient.

The microscopical examination with a low power shows that the affected hair is covered at several places by roundish formations, partially or totally encircling the shaft. Using a higher power, these formations will be seen to consist, in the yellow variety, of enormous numbers of bacillary-like bodies embedded into an amorphous cementing substance. In the red and black varieties, in addition to these masses of bacillary bodies which are the mycelial segments of the *Nocardia*, large groups of cocci-like bodies are observed. The affection in our cases was never associated with chromidrosis.

In two of our patients the pubic hair was affected in addition to the hair of the axillæ.

Diagnosis.—This is based on the presence of yellow, black, or red, rather soft, nodules on the hairs of the axillary regions, which, on microscopical and cultural examination, show presence of *Nocardia tenuis* alone, or with chromogenic cocci.

Differential Diagnosis.—The condition must be differentiated from other nodular parasitic conditions of the hair. As is well known, the principal nodular affections of the hair of parasitic origin are:—

1. Trichosporosis tropica, or piedra.
2. Unna's trichosporosis, or piedra nostras.
3. Behrend's trichosporosis, or 'nodular trichomycosis.'
4. Beigel's trichosporosis, or tinea nodosa.
5. Du Bois's trichosporosis.
6. Lepothrix, or Pick's trichomycosis palmellina, or trichomycosis nodosa of temperate zones.

1. Trichosporosis tropica, or piedra, generally affects the hair of the head. The nodules are extremely hard, hence the name 'piedra.' The fungus found belongs to the genus *Trichosporon* (*Trichosporon giganteum* Behrend 1890).

2. Unna's trichosporosis, or piedra nostras, has been described by Unna in the hair of the moustache and beard. It is due to *Trichosporon ovale* (Unna, 1896).

3. Behrend's trichosporosis, or 'nodular trichomycosis,' described by Behrend, affecting the hair of the beard. It is due to *Trichosporon ovoides* (Behrend, 1890).

4. 'Beigel's trichosporosis,' or 'tinea nodosa,' discovered in London by Cheadle and Morris, and later in Breslau, Nancy, etc. It attacks the hairs of the head, and is due to *Trichosporon beigeli* (Rabenhorst, 1867).

5. Du Bois's trichosporosis of the hairs of the pubic region due to *Trichosporon glycophiles* (Du Bois, 1910).

6. Lepothrix (E. Wilson), or trichomycosis nodosa of temperate zones (Patterson), or trichomycosis palmellina (Pick). In this

condition, as described by Paxton, Wilson, Pick, and later by Payne, Patterson, Crocker, Pusey, etc., the hairs present irregular, lobed masses of hard consistency, in which are often embedded some of the fibres of the cortex. According to Crocker, the fibres of the whole shaft may be split up, and the hair may break off with a brush-like termination. The researches on the ætiology of this condition seem to have given widely different results: Payne and Patterson described a short bacillus which penetrates under the cortical scales. Eisner describes a diplococcus, his results being confirmed by Sonnenberg; Colombini has found cocci; Babès, Pick, Balzer, and Barthemly, having found the condition often associated with red sweat, consider the bacillus found to be the *Bacillus prodigiosus*.

Trichomycosis axillaris flava, rubra, and nigra has nothing to do with piedra or with any other form of trichosporosis, as no *Trichosporon* is found, the fungus being a *Nocardia*, with very thin, bacillary-like mycelium. The condition somewhat resembles lepothrix. It differs from the typical lepothrix of temperate zones by the nodules being soft, easily removed, and by the hairs not becoming brittle. Moreover, it is easily cured.

Course and Prognosis.—The course is chronic, but the condition may subside or disappear on the patient going to a cold climate. The affection, if of very little pathological importance, has a certain practical interest, being much objected to by patients, especially by ladies.

Treatment.—The treatment is not difficult: a very efficacious one consists in dabbing the hair two or three times daily with a solution of formalin in spirit (℥i.-℥vi.) and applying at night a sulphur ointment (2 to 5 per cent.).

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CHAPTER LXIV

SKIN DISEASES (*continued*) —TROPICAL DERMATOMYCOSES (*concluded*)

Mycetoma—Mycetomatosis and actinomycosis—Pinoy's and Ravaut's nodular nocardiasis—Yuxta—Articular nodules—Rarer nodular and gummatous affections of hyphomycetic origin—References.

'MYCETOMA.'

Synonyms.—Madura foot, the Fungus disease of India, Godfrey and Eyre's Tubercular disease, Endemic degeneration of the bones of the foot, Morbus tuberculosis Pedis, Morbus Pedis Entophyticus, Podelkoma, La Maladie de Ballingall, Slipada, Hatty-ka-Pung, Keerenagrah (signifying a dwelling of worms), Kirudeo (signifying a dwelling of worms), Ghootloo Mahdee (signifying eggs of insects; probably so called from the small bodies found in the discharge).

Definition.—'Mycetoma' is a generic term for the invasion of the tissues of the foot and hand, and more rarely other parts of the body by fungi belonging to the genera *Nocardia*, *Aspergillus*, *Sterigmatocystis*, *Indiella*, and *Monosporium*, which produce enlargement, deformity, and destruction of the affected area.

History.—It is probable that mycetoma was known to ancient Indian writers on medicine, for references are found in their works to a disease of the foot characterized by swellings like plum-stones, associated with a considerable amount of discharge, and thought to be due to injuries caused by thorns.

In 1712 Kaempfer drew attention to a disease of the foot, which he called 'perical,' or large foot, in natives of India. It is not very clear what he meant by this, as he may have confounded elephantiasis with mycetoma. In the early nineteenth century the disease was well known in the South of India, where it was called 'Madura foot,' being described by Heyne in 1806, and mentioned in Brett's 'Surgery,' in 1840 as a distinct disease. In 1842 Gill appears to have been the first to clearly differentiate it, and he was followed by Godfrey in 1844 and 1846, Morehead in 1846, Colebrook in 1848; but many of these early writers appear to have considered the disease to be tubercular.

Ballingall, in 1855, was the first to state that it was probably of parasitic origin, and he was followed by Rustomji, who gave careful clinical histories of eight cases.

In 1860 Eyre gave an account of the disease, and V. Carter published the first of a series of most important papers extending till 1874, in which he studied the whole subject most minutely, and found the causal agent to be a fungus. In 1859 he discovered the fungus of the melanoid or black variety, now called *Madurella mycetomi* Laveran 1902, and later, in the same year, he found the fungus of the ochroid, or white variety, which is at the present time

called *Nocardia maduræ* Vincent 1894. He was followed by a large number of observers, among whom may be mentioned H. J. Carter, who in 1862 described a fungus belonging to the Mucoridæ, which Berkeley in 1865 called *Chionyphe carteri ;* but their methods of separating and growing this fungus were crude, and there is no doubt that it was a contaminative fungus. Lewis and Cunningham in 1875 did not believe in the *fungoid* origin, and ascribed the disease to degenerations ; and in 1876 Kemper and Jamieson described a curious case of foot disease under the term 'podelcoma' as occurring in America. It is probable that this may have been a case of mycetoma, but if so, it was remarkably acute in its course. Bassini in 1888 described an undoubted case in Italy, and Wright a similar case in an Italian in America. In 1892 Kanthack and Hewlett independently studied the pathology of the disease, and concluded that it was really an actinomycosis. In 1893 Boyce and Surveyor examined a number of cases and grew the fungus artificially. In 1894 Vincent published an account of a case of the white variety occurring in Algeria. He cultivated the parasite, and inoculated it without success into animals, and finally named the variety *Streptothrix maduræ*, thus clearly differentiating one variety of the disease.

In 1895 Adami and Kirkpatrick published an account of the first undoubted case in Canada, and later similar cases were reported in other parts of America, and in 1897 Unna studied the pathology of the disease. In 1901-02 Bouffard described black and white varieties of the disease as occurring in Somaliland.

In 1902 Laveran investigated Carter's black variety, and named the fungus *Streptothrix mycetomi ;* and Foulerton and Jones published an important paper on the Streptothrix group. Nicolle and Brunswic-le-Bihau described a case of white mycetoma in Tunis, caused by *Aspergillus nidulans*, cultivated by Nicolle and Pinoy. The fungus was probably introduced into the foot by a grain of barley. In 1906 Brumpt published a most valuable paper, showing that actinomycosis was the cause of one variety of mycetoma, and that Carter's, Vincent's, Nicolle's, and Bouffard's white and black mycetomata were all separate varieties of the disease caused by distinct fungi, and in addition, he described two other varieties, making a total of eight varieties due to separate fungi. In 1907 Musgrave and Clegg described a new form of the disease in the Philippine Islands, due to *Streptothrix freeri*, which they successfully inoculated into the foot of a monkey. This fungus they now consider to be identical with *Nocardia asteroïdes.*

In 1910 and 1911 Tarozzi and Radaeli grew from two cases in Italy a fungus which the first observer considered to be a *Nocardia*, while Radaeli and Saccardo have described it as a new species of the genus *Monosporium.*

In 1912 Brault in Africa succeeded in growing on artificial media madurella mycetoma, and probably the same fungus was grown in India by Chatterjee.

Climatology.—The disease is diffused throughout the world, being known in Asia, Africa, Europe, and America, but is far more commonly met with in the tropics than in the temperate zone, and is especially prevalent in India, particularly in the Madras Presidency about Madura, Bellary, Tanjore, and Trichinopoli.

In Asia it is known in India, not merely in Madras, but also in Cochin, Pondicherry, Sind, Cutch, Bengal, Rajputana, the North-West Provinces, the Punjaub, and Kashmir. It also occurs in Ceylon and Aden. In Africa it is also widespread, being met with in Madagascar, Somaliland, Abyssinia, Jibuti, the Sudan, Egypt, Tripoli, Tunis, Algeria, Morocco, and Senegambia. In Europe it is rarely met with, but cases have been reported from Cyprus, Italy, Greece and France. In America it has been reported as occurring in Canada, the United States, Nicaragua, the West Indies, Argentina, Brazil, and Chili.

With regard to the known distribution of the varieties, the

actinomyotic has only been reported from Madagascar; Carter's black mycetoma from India, Italy, and Senegambia and Northern Africa; Carter's ochroid variety from India, Somaliland, Abyssinia, Algeria, Cyprus, Cuba, and Argentina; Bouffard's black and white varieties from Somaliland; Brumpt's white variety from India; Reynier's white variety from Paris; and Musgrave and Clegg's from the Philippine Islands. Lindenberg's white mycetoma from Brazil, Pelletier's red mycetoma from Senegal, Tarozzi-Radaeli white mycetoma from Italy. It is not definitely known what influence the season of the year has on the occurrence of the fungus, though probably when the saprophytic history is known some such influence may be discovered.

Ætiology.—The disease is due to the entry of a fungus into the subcutaneous tissue of some part of the body by means of a wound.

The region invaded is usually the foot, more rarely the hand, and still more rarely some other region.

The causal fungi may be classified as follows:—

Order.	Genus.	Species.
Ascomycetes ..	Aspergillus E. Micheli 1725	A. bouffardi Brumpt 1906.
	Sterigmatocystis Cramer 1869	S. nidulans Eidam 1883.
	Madurella Brumpt 1905	M. mycetomi Laveran 1902.
		M. tozeuri Nicolle and Pinoy 1908.
		M. bovoi Brumpt 1910.
	Indiella Brumpt 1906	I. mansoni Brumpt 1906.
		I. reynieri Brumpt 1906.
		I. somaliensis Brumpt 1906.
Hyphomycetes	Nocardia Toni and Trevisan 1889	N. maduræ Vincent 1894.
		N. asteroïdes Eppinger 1890.
		N. pelletieri Laveran 1906.
		N. bovis Harz 1877.
		N. israeli Kruse.
	Sporotrichum Link 1806	S. beurmanni Matruchot and Ramond 1905.
	Monosporium Bonord and Saccardo 1903	Monosporium apiospermum Saccardo 1911.

The saprophytic life of these parasites is quite unknown, with the sole exception of *Nocardia bovis*, which lives in the spikelets of various cereals.

The disease occurs most commonly in people who walk barefoot, and is therefore most usually met with in native races, though race *per se* has no predisposing influence. It is principally found in agricultural labourers, and is therefore more common in the poorer classes and in males.

Pathology.—The causal fungus is introduced into some part of the body by a wound produced by a thorn, a splinter of bamboo or other wood, by a sharp stone, knife, etc., but perhaps the most interesting recorded case is Nicolle's Tunis case, in which the disease was started by an injury to the foot by a grain of barley. Once introduced into the subcutaneous tissues, it commences to grow, the original wound in the meantime healing. Usually

the growth is slow; but if Kemper and Jamieson's case was true mycetoma, it may be rapid, and, indeed, this is supported by Musgrave and Clegg's inoculation of *Nocardia asteroïdes* into a monkey's feet, in which the swelling developed in ten to sixteen days, and was quickly followed by suppurative lesions. As the fungus grows it destroys the tissues of the foot, and meets with but little reaction on the part of the body, and no attempt is made to repair its ravages. The reaction on the part of the body confines itself to a lymphocytic infiltration around the fungus, and later the formation of granulation tissue, with epithelioid and giant cells at times; while, finally, fibrous tissue is formed around the fungus and its surrounding cells, and the vessels become blocked by an endarteritis and periarteritis. This appears to be an attempt to encapsule and prevent the spread of the parasite, as well as to damage it by cutting off its food-supply.

At the same time the cellular exudate becomes a thin, oily, occasionally stinking, pus, and works its way to the surface, forming apertures, and carrying the parasite with it. This must be considered to be an attempt to rid the body of the fungus.

In the meanwhile the parasite, if of certain species, forms special club-shaped hyphæ considered to be chlamydospores, which at first serve for extracting nutrition from the surrounding leucocytes, but later, breaking free from the main mass, form means of asexually propagating the fungus in the foot. Some of these separated clubs are attacked and engulfed by leucocytes, and though it is possible that in this way many may be destroyed, still, Brumpt's researches show that the leucocyte, with its enclosed club, may wander away from the diseased area into healthy tissue, and may be killed by the club, which, being set free, grows into a new mass of fungus. In this way the fungus may be disseminated by means of the phagocytes.

When surrounded by pus, the fungus gathers itself into granules, the so-called sclerotia, which show externally radially arranged fibres or clubs, and internally a mass of mycelium with crystals and débris, the latter being most marked in the centre. These granules escape to the exterior, and form the yellow, black, or pink granules in the discharge. As the fungus grows in the foot the connective tissues and the muscles undergo vitreous degeneration, and break up into débris, amongst which pieces of nerves and tendons may be found, while even the bone in some cases becomes attacked by a form of degeneration and disappears. The result is that the foot appears much swollen externally, and shows the openings of the sinuses, through which the pus and the fungoid granules escape; while internally the normal structure may have completely disappeared, being replaced by degenerated tissue, débris, sinuses, and fibrous sacs containing the fungus and the pus.

The result is, however, not merely destruction of the foot, but also great bodily waste, due to the continuous discharge, so that the patient becomes emaciated, and may finally die of cachexia.

Very rarely do the fungi invade the body, as is the case with *Nocardia bovis and N. israeli*, which may give rise to a general infection.

The peculiarity of the pathology is the slight reaction which the body makes against the invasion by the fungus, and the entire absence of any attempt at repair.

The black varieties of mycetoma owe their colour to a dark substance which the fungi secrete. The nature of this black substance is not known. It is soluble in hot sulphuric acid, forming a yellowish-red solution, but is not soluble in cold sulphuric acid nor in potash solutions. According to Thudichum, it does not contain hæmoglobin in any form, though a small quantity of iron is present. The nature of the yellow pigment does not appear to have been investigated, though Musgrave and Clegg remark, with regard to *Nocardia asteroides*, that a pigment of the appearance of hæmoglobin may be found.

Experimental Reproduction.—Several observers have tried to reproduce the disease in monkeys and other animals, in some cases with a certain degree of success. We recommend Pinoy's method of inoculating the cultures on bits of wood which are inserted into a small wound. Pinoy has inoculated with success in the pigeon *Madurella tozeuri*. The experimental inoculation with *Madurella mycetomi* has not yet succeeded.

Morbid Anatomy.—Externally the swollen foot shows nodules and openings, the latter of which lead into the sinuses. In sectionizing the foot it will be noticed that the sinuses run in various directions are communicating, and end in small cavities containing pus and the fungus, and that these cavities are embedded in degenerated tissue and débris.

The bone may or may not be affected, but if it is, the whole foot can be easily cut by a knife.

Histopathology.—The histopathology has been studied by Unna, Vincent, and very completely by Polverini, Musgrave and Clegg. Microscopically the tissues show degeneration and débris, with fibrous tissue formation, endarteritis, and periarteritis, and at times absorption of the bone.

The microscopical examination of sections of the tissues typically affected—viz., of alveolar appearance—and containing mycotic grains show a central roundish mass—the mycotic grain—a clear circular space, and the surrounding degenerated tissues. The clear space is due to the fact that the thin purulent matter in which the granule is embedded contracts during fixation with alcohol. The mycotic granule is composed at the centre almost exclusively of mycelial elements with a few leucocytes; more externally there are masses of amorphous substance, staining lightly purplish with eosin, in which a few mycelial threads may be seen. The periphery shows a polymorphonuclear infiltration. The walls of the alveolar cavities containing the granules are formed of young connective tissue with numerous plasma cells and occasionally giant cells; there is a marked proliferation of bloodvessels.

Symptomatology.—The disease usually begins in the foot, more rarely in the hand, and still more rarely in the leg, knee, neck, or trunk. There may or may not be a history of a cut or injury some time previously. In any case this primary injury will have healed long before the disease is well established.

The incubation period in well-recorded cases would appear to be short; thus, in Musgrave and Clegg's case, one month after the primary injury the wound reopened and discharged pus, and in

FIG. 588.—MYCETOMA.

their experiments on monkeys it appeared to vary from ten to sixteen days. Further researches on this point are, however, required.

The earliest signs are either pain or swelling in the region of the original injury, which is usually on the sole of the foot, between the toes, or on the instep. The swelling becomes a hard lump, on the surface of which a bleb may form, which bursts and reveals a small opening discharging an oily, rarely sanious, thin, offensive pus, in which the granules characteristic of the fungus may be found.

Some new indurations and nodosities appear in various parts of the foot, and new openings are formed, while the whole foot begins to swell in a very characteristic manner. First the arch of the

PLATE XII.

MYCETOMA.

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foot fills up and disappears, the whole sole becoming so swollen and convex that the toes are no longer able to touch the ground, and may be pushed apart, but are usually not affected by the disease. At the same time the dorsum of the foot becomes studded with nodules and openings. The colour of the integument may be normal, but is usually darker than in the healthy skin. It is rarely œdematous. The openings, when examined by a probe, are found to lead into sinuses, which penetrate deeply into the tissues, and at times even into the bones of the foot. The quantity of the discharge varies from time to time, being increased by motion. On palpating the affected area, it is found to be elastic, and the sensibility to be normal. The inguinal glands are often enlarged and hard.

As the disease progresses, pain, which at first was slight, becomes more marked, especially in cold weather. The patient ceases to be able to place the foot to the ground, and is compelled either to walk on the heel or to use a support. The leg begins to waste, and after a long time the patient becomes weak and anæmic from the constant drain on the system, by the discharge, and possibly also by toxins produced by the fungi. General constitutional disturbance of a febrile nature is rare.

The disease is very chronic, and has no tendency to heal, and if not treated, will eventually cause the death of the victim, from exhaustion or diarrhœa, after lasting some ten or twelve years.

Varieties.—The disease can be classified by the different causal fungi into varieties, which may be arranged, according to the colour of the granules or sclerotia, into the black or melanoid group, the white or ochroid group, and the red group, as follows :—

A. The Melanoid Group.

1. Carter's black mycetoma.
2. Bouffard's black mycetoma.
3. Nicolle and Pinoy's black mycetoma.
4. De Beurmann's sporotrichic mycetoma.
5. Bovo's black mycetoma.

B. The Ochroid Group.

6. Carter's white mycetoma.
7. The actinomycotic white mycetoma
8. Nicolle's white mycetoma.
9. Brumpt's white mycetoma.
10. Reynier's white mycetoma.
11. Bouffard's white mycetoma.
12. Musgrave and Clegg's white mycetoma.
13. Lindenberg's white mycteoma.
14. Tarozzi-Radaeli white mycetoma.

C. The Red Group.

15. Pelletier's red mycetoma.

1. *Carter's Black Mycetoma.*—The sclerotia are hard, irregular, brittle, black or dark brown in colour, 1 to 2 millimetres in diameter. The hyphæ are white, but the interhyphal substance is dark brown. This is the type of the disease, and is caused by *Madurella mycetomi* Laveran 1902.

2. *Bouffard's Black Mycetoma.*—The sclerotia are moriform, elastic, and vary in size from a pin's head to a small pea. The disease, which is readily amenable to treatment by curetting, is caused by *Aspergillus bouffardi* Brumpt 1906.

3. *Nicolle and Pinoy's Black Mycetoma.*—The sclerotia are hard, small, and black. During parasitic life the mycelium is septate, 1 to 4 μ in breadth. Chlamydospores are present. It is found in Algeria and Tunis, and is due to *Madurella tozeuri* Nicolle and Pinoy 1908.

4. *De Beurmann's Black Mycetoma.*—A case with all the clinical features of madura foot has been described by De Beurmann as due to *Sporotrichum beurmanni* Matruchot and Ramond 1905.

5. *Bovo's Black Mycetoma.*—This variety has not yet been completely investigated. Bovo in Italy observed a case of nodular affection of the foot, the affected tissues presenting mycotic black masses. He considered his case to be due either to *Aspergillus fumigatus* or to *Sterigmatocystis nigra*. Cultures were not obtained, while Brumpt considers the fungus *pro temp.* to be a *Madurella—M. bovoi* Brumpt 1910.

6. *Carter's White Mycetoma.*—The sclerotia are yellowish-white, mulberry-like, spherical grains, varying in size from minute pin-heads to peas. It is caused by *Nocardia maduræ* Vincent 1894.

7. *Actinomycotic White Mycetoma.*—The sclerotia are yellowish sulphur colour, and soft. The disease destroys the bones, and can spread throughout the body, forming metastases in distant organs. The causal fungi are *Nocardia bovis* Harz 1877 and *N. israeli* Kruse 1896.

8. *Nicolle's White Mycetoma.*—The sclerotia are large, rounded, and smooth, like peas. It attacks the bones. The causal fungus is *Sterigmatocystis nidulans* Eidam 1883.

9. *Brumpt's White Mycetoma.*—The sclerotia are very small, hard, and bean-shaped. The causal fungus is *Indiella mansoni* Brumpt 1906.

10. *Reynier's White Mycetoma.*—The sclerotia are small, white, soft, coiled masses. It is due to *Indiella reynieri* Brumpt 1906.

11. *Bouffard's White Mycetoma.*—The sclerotia are small, very hard spherical or polyhedral grains, sometimes white, sometimes reddish-yellow in colour. It destroys bone. It is caused by *Indiella somaliensis* Brumpt 1906.

12. *Musgrave and Clegg's White Mycetoma.*—The sclerotia vary in size from 0·25 to 5 millimetres. Oval at first, they become variously shaped when full-grown. The fungus which invades the medulla of the bone is *Nocardia asteroïdes* Eppinger 1890.

13. *Tarozzi-Radaeli White Mycetoma.*—This variety has been

found in Italy by Tarozzi and Radaeli. The foot presents several nodules, from which some purulent liquid exudes. The grains are yellowish, small, rather hard. The microscopical examination does not show clubs. The fungus causing it was first observed by Tarozzi, who considered it to be a *Nocardia*, and independently by Radaeli, who considered it to belong to some other genus. It has been described by Saccardo under the name of *Monosporum apiospermum* Saccardo 1911.

Radaeli does not consider his case to be mycetoma, as he limits this term only to conditions due to fungi of the genus *Nocardia*. Under our definition of the malady, however, the cases described by Tarozzi and himself come under this heading.

FIG. 589.—PSEUDO-MYCETOMA OF FRAMBŒSIAL ORIGIN.

14. *Lindenberg's White Mycetoma.*—This variety was found by Lindenberg in Brazil. The grains are very small, white-yellowish, soft, moriform. It is caused by *Nocardia braziliensis* Lindenberg 1909.

15. *Pelletier's Red Mycetoma.*—This variety is common in Senegal and other parts of Africa, and has been described by Pelletier and Thiroux. It often attacks other regions of the body besides the foot. The grains are very small and of a red colour. The fungus is *Nocardia pelletieri* Laveran 1906, a description of which will be found in the chapters on fungi.

Diagnosis.—The peculiar swelling of the foot, with a filling-up of the arch, and the formation of sinuses from which a discharge containing the typical sclerotia is escaping, enables the disease to be diagnosed with certainty from elephantiasis or tubercular disease of the foot.

The variety of the fungus may be determined by examining the grains or the scrapings of the sinuses microscopically, culturally, and by inoculations in animals.

It is to be noted that the typical grains may for a time be absent

from the purulent liquid exuding from the sinuses. In such cases squeezing of the nodules may make the grains appear, or a nodule which has not yet opened may be incised and the contents examined.

Pseudo-Mycetoma.—Occasionally one comes across conditions of the foot clinically somewhat resembling madura foot, but of tubercular, filarial, or some other origin. In Ceylon a type of pseudo-madura foot not uncommonly observed is merely a late manifestation of framboesia. Austregesilo has described in South America a case of angiokeratoma of the foot clinically resembling mycetoma. The absence of the typical grains differentiates all these types of pseudo-mycetoma from true mycetoma.

Prognosis.—The disease is incurable unless treated surgically.

Treatment.—The diseased area, if localized, may be removed by curetting or excision ; but if a large area of the foot is affected, amputation must be performed well above the boundary of the disease. Potassium iodide has very little or no effect.

Prophylaxis.—Prophylaxis consists in guarding against wounds from pieces of wood, stones, etc., by wearing boots, shoes, or sandals. Should a wound occur, it must be thoroughly cleaned with antiseptic lotions, or better perhaps tincture of iodine, before being allowed to heal.

MYCETOMIASIS OF THE BODY, ACTINOMYCOSIS AND PSEUDO-ACTINOMYCOSIS.

Remarks.—The fungi producing madura foot may occasionally invade other parts of the body instead of, or in addition to, the foot. They may attack the skin and deeper tissues of the hands, trunk, mammæ in females, and also the deep organs, lungs, heart, liver, brain. For such conditions the term 'mycetomiasis' may be used, and when the fungi found are *Nocardia bovis* and *Nocardia israeli*, the term 'actinomycosis' is generally employed. These two fungi, in fact, very seldom attack the foot. Some authorities use the term 'pseudo-actinomycosis' to indicate the condition induced by *N. ponceli* Verdun 1912, *N. liquefaciens* Hesse 1892, *N. gasteni* Brumpt 1910, and generally to conditions due to *Nocardias* not producing definite grains in the pus.

Symptomatology.—The lesions resemble, to a certain extent, those found in the foot. The condition generally begins with indolent nodules in the skin or subcutaneous tissues ; the skin over them becomes tense and glossy, and finally the nodules break down with formation of sinuses from which a purulent liquid exudes, containing the characteristic granules, of various sizes and colour, as described in madura foot. Occasionally the ulcerated lesions become fungoid and large, and papillomatous purplish tumours may develop. The location of the lesions varies. The type caused by *Nocardia israeli* Kruse and *N. bovis* Herz, or *true actinomycosis*, as found also fairly frequently in temperate zones, is most frequently situated on the lower region of the face and neck, especially in the tissues under the jaw. In cattle it produces the well-known condition known as wooden tongue. It is characterized by the presence of sulphur-yellow grains in the pus. Of actinomycosis, besides the cervico-facial situation, which is the commonest, the following types have been described : The parietal, attacking the walls of the thorax and abdomen ; the broncho-pulmonary ; the abdominal (liver, etc.) ; the cerebral (very rare), in addition to the rare type situated on the foot (actinomycotic mycetoma).

Prognosis.—This depends greatly on the species of fungus causing the malady. The types due to *Nocardia bovis*, *N. israeli*, or true actinomycosis, answer well to a potassium iodide treatment.

Diagnosis.—This is based on the presence of indolent or nodular masses breaking down with formations of pus, in which grains containing the fungi are found.

Treatment.—Potassium iodide in full doses (gr. xx.) four times a day should always be administered.

Nodular Nocardiasis of Pinoy and Ravaut.

Historical and Geographical.—This condition and its fungus were studied by Pinoy and Ravaut in France.

Ætiology.—The condition is caused by a *Nocardia*. Only one case is known, described by Pinoy and Ravaut—and due to *N. thibiergei* Pinoy and Ravaut 1909 (see p. 817).

Symptomatology.—In the only case on record there were numerous subcutaneous and intramuscular gummatous nodules which had developed very slowly; they slowly softened, some ulcerating. In the pus the fungus was found.

Treatment.—Potassium iodide is to be recommended.

Other nodular affections of nocardial origin, and characterized by the presence of abscesses, or gummata in which fungi of the genus *Nocardia* are found, have been described by Rivière and others, and very ably in England, by Foulerton.

Juxta-Articular Nodules.

Synonyms.—'Enno,' Naridé, Steiner's tumours, Jeanselme's nodules.

Historical and Geographical.—This affection was first briefly described by Macgregor in 1901 in New Guinea, who also suggested a possible parasitic origin of it. It was later more fully studied by Steiner in natives of Java, by Jeanselme in natives of Siam, where it is known as 'enno.' Jeanselme introduced the very appropriate term of 'juxta-articular nodules.' Fontoynont and Carougeau in Madagascar discovered the cause of the affection to be a fungus, *Nocardia carougeaui* Brumpt 1910. Cases have been observed in Northern Africa by Gros and in Ceylon by us. The disease will probably be found to occur in many other tropical and subtropical countries.

Ætiology.—Macgregor, Steiner, and Jeanselme considered the nodules to be of parasitic origin, while Fontoynont and Carougeau discovered the fungus which is the ætiological agent. The description of this fungus—*Nocardia carougeaui* Brumpt 1910—is given in the chapters on fungi (see p. 817).

Symptomatology.—In the legs and arms, especially in proximity to the articulations, several nodules are found, some of them the size of a walnut or more, of rather hard consistency, and covered by healthy skin. According to Macgregor, these tumours occur most frequently, about the elbows, or the parts of the body coming in contact with the ground when the native is sleeping. These nodules at first are rather soft, and are situated in the subcutaneous tissue, and the skin may be moved above them. Later they may,

apparently, fuse together, forming hard, large tumours, and adhere to the skin, which generally does not present any alteration. The

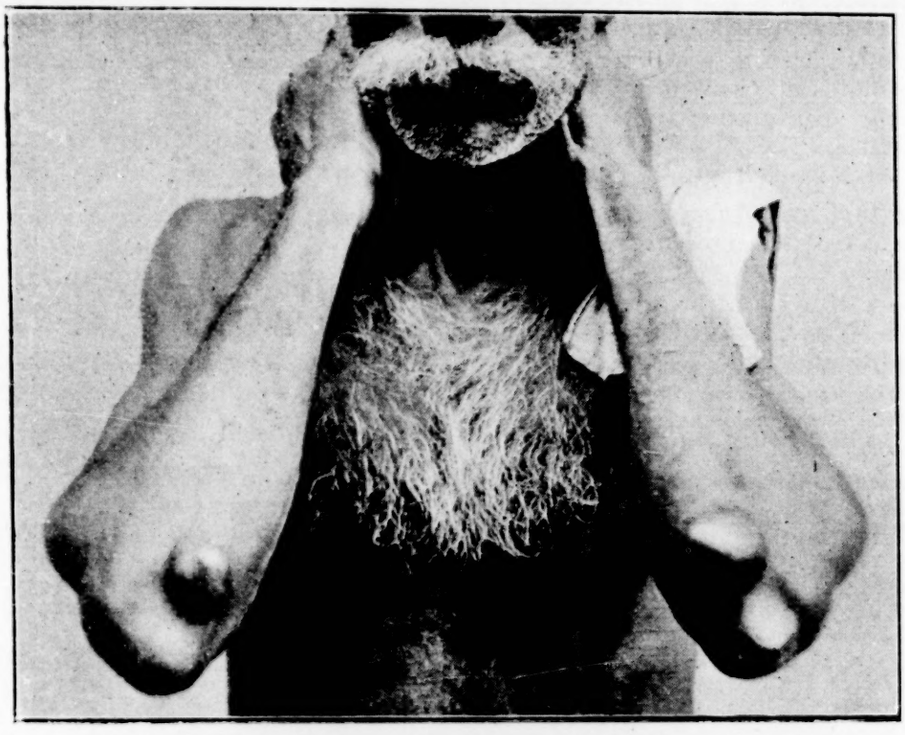

FIG. 590.—JUXTA-ARTICULAR NODULES.

FIG. 591.—JUXTA-ARTICULAR NODULES.

course is very chronic, but occasionally the nodules may disappear spontaneously.

Treatment.—The nodules may be excised. In the very first stage of the disease a potassium iodide treatment might be tried.

RARER NODULAR AND GUMMATOUS AFFECTIONS OF HYPHOMYCETIC ORIGIN.

Hemisporosis.

Historical and Geographical.—Gougerot and Craven described a case of osteo-periostitis due to *Hemispora stellata* Vuillemin some years ago. Later Auvray and Bidot found the same fungus in a generalized nodular affection, and De Beurmann, Clair, and Gougerot found it in a gumma situated on the penis of a negro.

Ætiology.—The condition is due to a fungus, *Hæmispora stellata* Vuillemin, the description of which is given in the chapters on Fungi.

Histopathology.—The histological lesions resemble those of tuberculosis cutis, as noted by Auvray and Bidot.

Symptomatology.—Gumma-like swellings are present either single or multiple. These may later ulcerate. A chronic osteoperiostitis, with thickening of the tibia somewhat resembling the type due to syphilis, has been described. Mercury, however, had no effect.

Diagnosis.—This is based on isolating the fungus. The fungus microscopically is seldom if ever seen in the lesions, and cultures are necessary. These are carried out in the same manner as for sporotrichosis.

Treatment.—Potassium iodide given in full doses (gr. xv.-xx.) three times daily is very efficacious.

Acremoniosis.

There is only one case on record of this condition by Potron and Noisette in France. The condition is due to a fungus, *Acremonium potronii* Vuillemin 1911, which has been described in the chapters on Fungi (see p. 842). The patient had fever which was at first suspected to be typhoid, and several gumma-like swellings developed, which slowly ulcerated. They were not painful. The proximal glands were not enlarged.

Diagnosis.—This is based on finding the fungus by cultural methods.

Treatment.—In the only case known an intensive potassium iodide treatment cured the condition.

Enantiothamnosis.

Definition.—A nodular condition due to a fungus, *Enantiothamnus braulti* Pinoy 1911.

Historical and Geographical.—This condition has been described by Brault in Northern Africa, who isolated the fungus, the complete botanical description of which we owe to Pinoy.

Ætiology.—The causative fungus is *E. braulti* Pinoy 1911 (see p. 841).

Symptomatology.—The condition in the only case so far known was characterized by the presence of nodules on the gluteal regions,

the size of a pea to a small egg. The nodules had a central crateriform opening, from which some pus exuded.

Diagnosis.—This is based on cultivating the fungus from the lesions.

Treatment.—This is surgical, but first potassium iodide might be tried.

Cladosporiosis.

Definition.—A nodular condition due to *Cladosporium madagascariense* Verdun 1912.

Remarks.—There is another tropical condition due to a fungus of the genus *Cladosporium*—viz., tinea nigra—but this affection is clinically so different that we do not give it under the heading Cladosporiosis. We have given a separate description of it (see p. 1502).

Historical.—Fontoynont isolated the fungus from a case in Madagascar. Gueguen placed it in the genus *Cladosporium*, and Verdun called it *C. madagascariense* Verdun 1913.

Symptomatology.—In the only case so far known, that of Fontoynont, gummatous nodules were present on the leg, some of which slowly ulcerated.

Treatment.—Potassium iodide has apparently very little efficacy in this condition.

Scopulariopsis.

This condition is due to *Scopulariopsis blochi* Matruchot 1911, and *S. koningii* Vuillemin 1912. Two cases have been reported so far from France. The patients presented gummata and verrucose patches on the skin. Lymphangitis was noted in one case. The diagnosis is based on finding culturally the fungi. The treatment consists in giving large doses of iodides.

It is to be noted that Pinoy and other authorities doubt the pathogenic rôle attributed to *S. blochi*.

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CHAPTER LXV

SKIN DISEASES (*continued*)—DERMATITIS VENENATA

Definition — Remarks — Classification — Rhus group — Euphorbia group — Urtica group—Tectona group—References.

Definition.—The term 'dermatitis venenata' includes a number of inflammatory skin lesions caused by the irritative action of poisonous principles contained in certain plants.

Remarks.—By the above definition it will be observed that the term 'dermatitis venenata' is here used in the restricted sense of being only caused by plants, leaving the dermatitis caused by animals to be treated in the chapter dealing with the Dermatozoiases.

When the poisonous principle is contained in the juice of cultivated plants, the poisoning is largely met with among gardeners, florists, and people associated with plants in some way; when, however, the poisoning is due to a principle contained in some special hairs of a plant, whether cultivated or not, it is obvious that anyone may be affected; and when it is due to principles contained in the dust from dry wood, it is also obvious that carpenters and persons who cut or saw this wood will be most liable to be affected.

We should not be surprised if, in the future, it will be found that certain forms of dermatitis venenata are due in reality to some parasitic micro-organisms living in the plants or woods, and which get inoculated. The fact that, for instance, satin-wood dermatitis appears several weeks after handling the satin-wood sawdust is rather in favour of there being some *contagium vivum* which requires some time to develop and multiply sufficiently to cause symptoms of disease.

With regard to the first series of cases in our experience, there can be no doubt that some people are more liable to the affection than others, and it would appear that certain people suffering from any form of seborrhœa or allied condition, no matter how mild, are especially liable to be troubled by dermatitis venenata.

With regard to *geographical distribution*, it is a cosmopolitan complaint, being found in all parts of the world. It, however, requires further study in the tropics, and it is for this reason that we have specially brought it forward in connection with skin diseases.

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